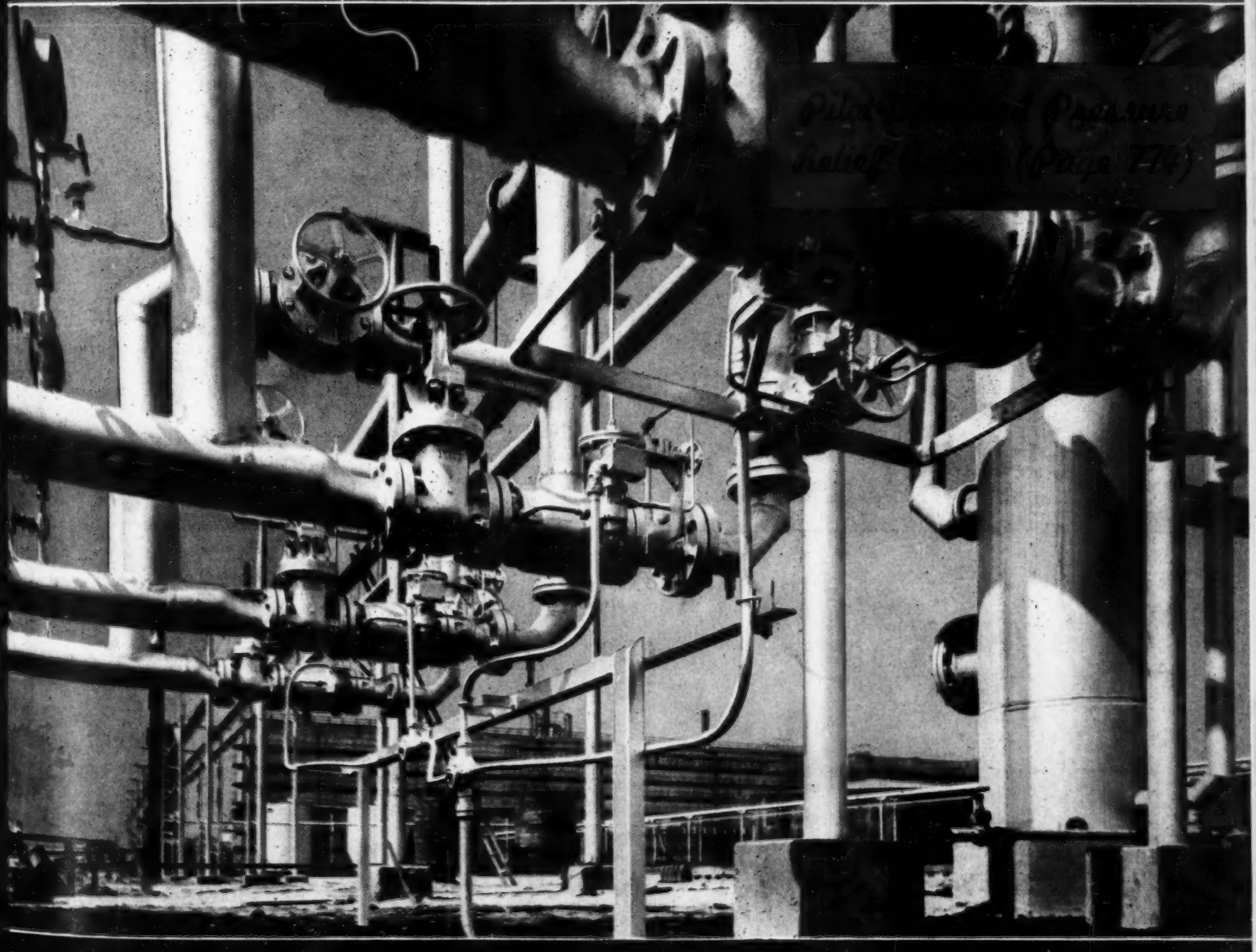
PETROLEUM PROCESSING

AUG 3 1 19
DETROIT

VOLUME 3, NUMBER 8 AUGUST, 1948



FORMERLY MONTHLY TECHNICAL SECTION OF NATIONAL PETROLEUM NEWS

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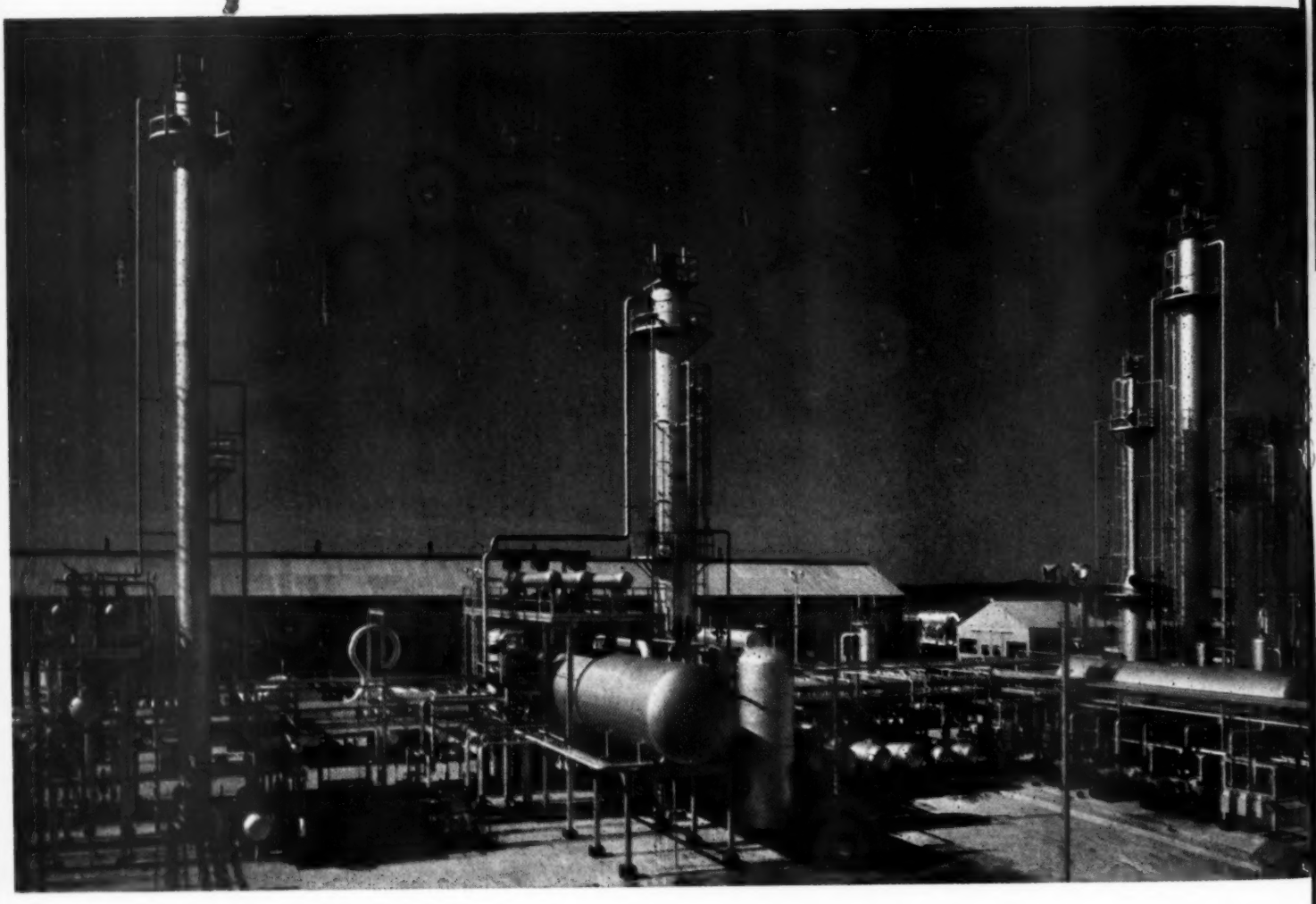

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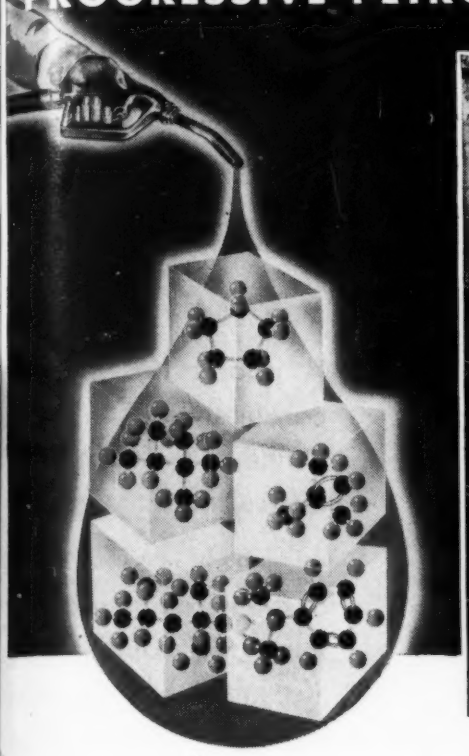
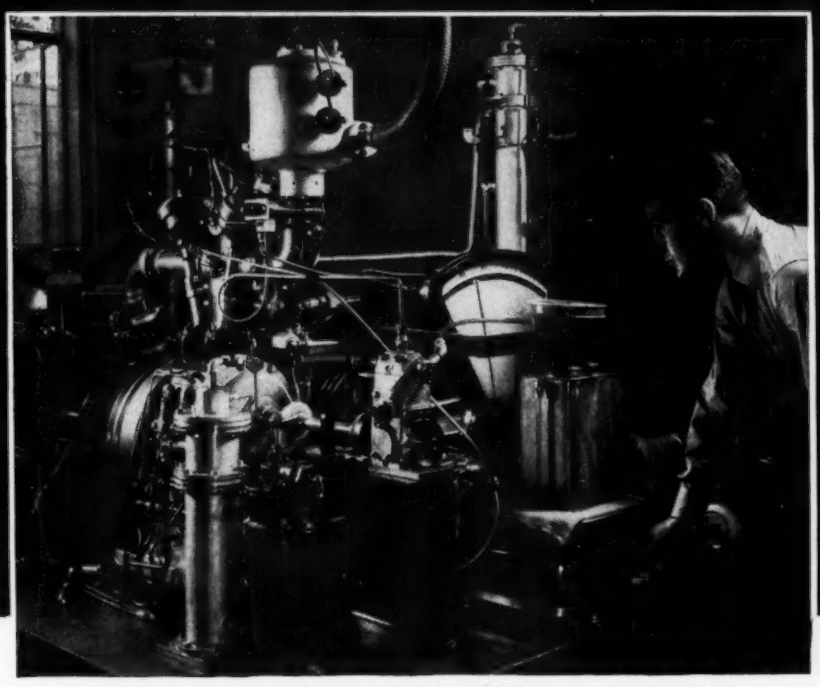
THE ETHYL CORPORATION SERVES THE PROGRESSIVE PETROLEUM INDUSTRY *Through Research*





Research on pure hydrocarbons is carried out on this "17.6" supercharged single-cylinder engine at Ethyl's Detroit Laboratories.

Making and evaluating hydrocarbons —the building blocks of gasoline

IN THE early days of the automobile, gasoline quality was considered to be principally a matter of volatility, which in turn was roughly indicated by "gravity." As new refining processes were introduced, however, and automotive engines were improved, it was found that fuels of equal gravity might not have the same volatility characteristics—and that neither indicated the performance of fuels in respect to "spark knock."

As a consequence, it was reasoned that fractions of given volatility from different crudes might be different in chemical nature and thus cause differences in behavior during burning in engines. Ethyl's research workers were among the first to conclude that a satisfactory explanation of differences in behavior of fuels in engines would require the maximum information concerning fuel hydrocarbons—the building blocks of which all gasolines are composed.

Thus, nearly twenty-five years ago, was born the idea behind one of Ethyl's fundamental research programs, which has been carried on continuously ever since for creation of a background of knowledge concerning hydrocarbons, and particularly about the combustion of hydrocarbons.

In 1926 the Ethyl Laboratories prepared all of the heptanes and a number of octanes. Among these early chemical curiosities was triptane, which is among the best of antiknock fuels known today. Normal heptane and iso-octane were first proposed by Ethyl as antiknock reference fuels and have since proved of inestimable value for this purpose.

During the intervening years many more pure hydrocarbons have been isolated and studied. In addition to work done independently, the Ethyl Laboratories have cooperated extensively with other laboratories of the oil and automotive industries in a program for the preparation and testing of as many as possible of the hydrocarbons likely to be present in gasoline. Research conducted or financed by Ethyl has included studies of hydrocarbons in specially designed engines, in laboratory combustion apparatus, and in spectroscopic equipment.

Background information on hydrocarbons is used by Ethyl, in cooperation with oil companies, for studies of experimental and commercial fuels. The aim of these studies is to find the combination into which such fuels may be blended along with tetraethyllead to form the best and most economical gasoline for present and future interests. As new refining processes are developed, they complicate the technology and economics of gasoline production. Thus these studies become increasingly important both to refiners and to engine manufacturers.

ETHYL CORPORATION

RESEARCH LABORATORIES

1600 West Eight Mile Road, Detroit, Michigan

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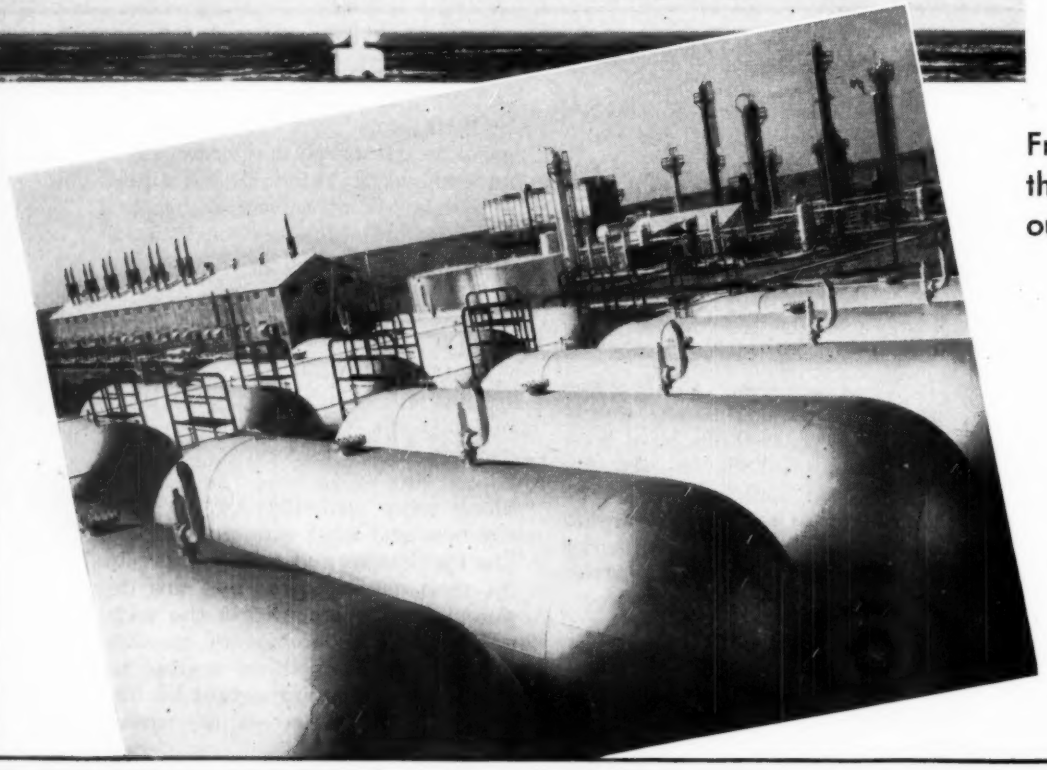
The Importance of Sound design

A poorly designed or carelessly erected plant is like a misspent life—difficult to remedy.

As surely as heritage and environment determine the course of a life, knowledge and experience predetermine the efficiency of a plant. Sound design and careful construction are all-important.



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Engineering and Construction Division

JONES & LAUGHLIN SUPPLY COMPANY

TULSA, OKLAHOMA

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VOLUME 3
NUMBER 8
AUGUST, 1948
PUBLISHED
MONTHLY

PETROLEUM PROCESSING

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OILGRAM PRICES
PLATTS'S OIL PRICE HANDBOOK

Covering the Management, Design, Operation, Equipment, Products of Plants Processing Crude Oil and Natural Gas into Fuels, Lubricants, Chemicals

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COVER STORY

★ **Indicates Exclusive in PETROLEUM PROCESSING**

STAFF: Warren C. Platt, Publisher; V. B. Guthrie, Editor; A. E. Kraft, Treasurer; D. P. Thornton, Jr., Assistant Editor; William F. Bland, Engineering Editor; William C. Uhl, Equipment Editor.
OFFICE: 1213 West 3rd St., Cleveland 13, Ohio, telephone CHerry 7672; Editorial Bureaus—50 West 50th St., New York 20, N. Y.; 1046 National Press Bldg., Washington 4, D. C.; 59 East Van Buren St., Chicago 5, Ill.; 904 World Bldg., Tulsa 3, Okla.

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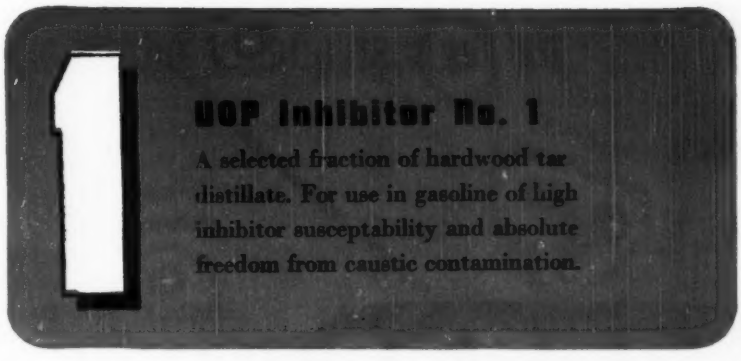
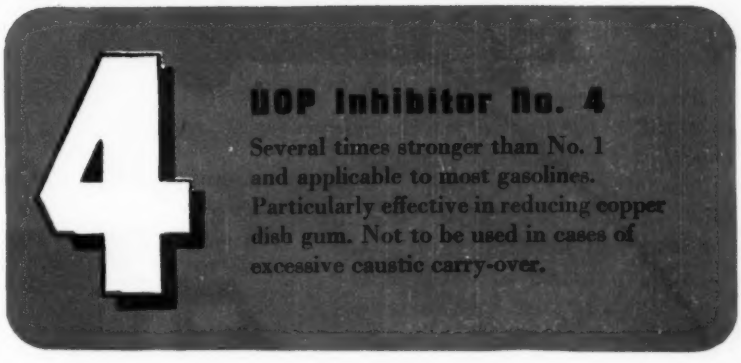
PROTECTION
for motor fuel quality

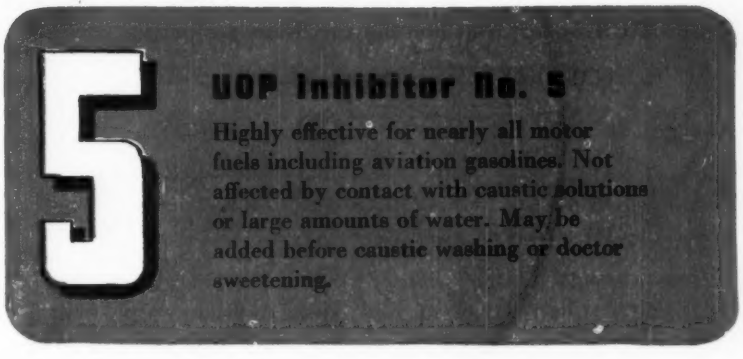
Gum formation and the decomposition of tetraethyl lead in gasoline result in lower quality . . . a less efficient fuel . . . a fuel that fosters customer dissatisfaction.

To help refiners deliver the best possible product, and one that will stay that way, UOP offers inhibitors 1, 4 and 5. These inhibitors *prevent* gum formation and the decomposition of tetraethyl lead.

Universal offers not only these three inhibitors, but in addition, assistance in choosing the inhibitor best suited to your product and help in applying the most efficient methods of treatment to your gasoline.


1
UOP Inhibitor No. 1
A selected fraction of hardwood tar distillate. For use in gasoline of high inhibitor susceptability and absolute freedom from caustic contamination.


4
UOP Inhibitor No. 4
Several times stronger than No. 1 and applicable to most gasolines. Particularly effective in reducing copper dish gum. Not to be used in cases of excessive caustic carry-over.


5
UOP Inhibitor No. 5
Highly effective for nearly all motor fuels including aviation gasolines. Not affected by contact with caustic solutions or large amounts of water. May be added before caustic washing or doctor sweetening.

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What's Happening!

AUGUST 1
1948

Summary of Current News Developments Concerning Oil Men

EXPANSION

Cosden Petroleum Corp. plans to rebuild the cracking plant at its 18,000 b/d Big Springs, Texas, refinery, damaged by fire in May, 1947. In rebuilding the old thermal plant it will be changed to Fluid catalytic cracking and will be operated under license from Universal Oil Products Co.

Imperial Oil's new $8,700,000 refinery, moved from Whitehorse, Yukon Territory, was scheduled to go on stream at Edmonton, Alberta, July 17. When in full operation at end of year it will have 6000 b/d capacity, which will be increased to 11,000 b/d when an additional $2,500,000 construction program now in progress in completed.

Indiana Standard has purchased a tract of approximately 960 acres in Hammond, Ind. adjacent to company's refinery at Whiting, Ind., for future expansion.

• • •

REFINERY OPERATIONS

Crude runs to stills continued upward last month, hitting a new peak of 5,791,000 b/d during the week ending July 10. That figure represented 99.0% of capacity operation, according to API figures. Previous record run was 5,736,000 b/d during week ending June 5.

A record-breaking run of 610½ days of continuous operation was recently established by Tide Water Associated Oil Co. with its Fluid catalytic cracking unit at Avon, Calif. The unit was first put in operation late in 1944, and since then has been shut down only three times, including this latest turn-around.

• • •

SYNTHESIS

Experiments in underground gasification of coal on a larger scale than carried out last summer are now being planned by the Bureau of Mines and Alabama Power Co. Cost of the large-scale field tests, including Bureau expenditures and those of the company which are reimbursable, is estimated at $411,000 for a one-year period.

A survey of synthesis plant sites is being made by Ford, Bacon & Davis, New York City engineering firm, under an $110,000-contract awarded it by the Army. Regions to be surveyed under what Army terms an "initial contract" are western Kentucky (coal), northwestern Colorado (shale) and southeastern Texas (natural gas).

The survey is being undertaken at the request of Interior Department, and will be limited to determining only general areas where requirements for one or more plants, as determined by Bureau of Mines, can be met. "Subject to the availability of additional funds," Army said, "it is planned to follow the initial contract . . . with a survey nation-wide in scope . . ."

Oil shale beds in western Colorado are again being studied to determine just how good are estimates that they hold fully 300 billion bbls. of oil. Sun Oil Co., Union Oil of California and Pacific Oil, a subsidiary of California Standard, have planned a diamond core drilling program with the Bureau of Mines and Office of Naval Petroleum Reserves which will start this summer.

A $750,000 lignite research laboratory is being planned by the Bureau of Mines at Grand Forks, N. D. Design has been started and construction is expected to get under way this fall, with completion scheduled for the end of 1949. Lignite, which represents nearly one-fifth of our coal reserves, is a high-moisture coal which tends to crumble upon exposure to air. The Bureau's research will include the development of more efficient coal-gasification methods.

• • •

PETROCHEMICALS

Co-polymerization of styrene with drying oils or resins has been developed in England, and the product, it is claimed, can be applied with equal success to produce high quality gloss enamels and flat wall paints. A new company, Styrene Co-Polymers Ltd., has been formed to manufacture the material on a commercial basis, and plans to build a plant at the Partington Industrial Estate near Manchester. Styrene will be supplied from the new petroleum chemicals plant already being built on the same Estate by Petrochemicals Ltd.

Chemical activities of Phillips Petroleum Co. have been expanded through the formation of a wholly-owned subsidiary, the Phillips Chemical Co. The new firm has been organized for the purpose of conducting Phillips' chemical and synthetic rubber

Information on these pages is obtained through the nation-wide news coverage services of PLATT'S OILGRAM NEWS

operations, as well as its furnace-type carbon black activities.

Manufacture of nitrogenous fertilizers is the first step in the program of the new Phillips Chemical Co. The company has leased the Cactus Ordnance Works at Etter in the Texas Panhandle, and also plans to build a new ammonium nitrate plant at Etter. Other plans call for a new ammonium sulfate plant on the ship channel near Houston, on a site large enough to permit the addition of the several other chemical plants which are projected.

• • •

MARKETS

July saw a general easing in the supply position of nearly all refined products. The only exceptions were prime grades of lubricating oils.

Gasoline supplies appeared sufficient in most areas to meet consumptive demand, although the situation could hardly be described as "plentiful." Quiet period for kerosine and distillate fuels was seasonal. For all light ends, prices on the high sides of price ranges were tending lower. Bidding of "premiums" by buyers, which was so pronounced on gasoline earlier this summer and as recently as a month ago on burning oils, slackened considerably. Postings of refiners for the most part were unchanged; it was from the angle of "gray market" bidding of premiums that prices sloughed off on the light ends.

Inventories of heavy fuels hit the top-heavy level in the Mid-Continent and along the Gulf coast. Group 3 price for No. 6 oil was off 10c to $2.40 per bbl.; still lower prices could not be confirmed. At the Gulf, prices for available cargoes of Bunker C dropped from around the $3.50 per bbl. level in mid-June to under $3.00 per bbl. late in July.

• • •

RESEARCH

The Texas Co. is expanding its research laboratories at Beacon, N. Y. Three new buildings are planned, which will increase facilities there by 40%. Texaco's research activities, according to W. E. Kuhn, manager of the company's Technical and Research Division, have tripled during the last decade.

Included in the present program, scheduled for completion in one year, are laboratories for volatility, lubrication and combustion studies; a chemistry building which will provide 18 complete laboratories for further development of new lubricants, and a third building which will provide office space and required services.

Continental Oil Co. has created a new Development and Research Department to co-ordinate activities in all departments of the company which come within these two categories. Manager of the new department is L. L. Davis, formerly supervisor of technical services of the company's Manufacturing Dept.

• • •

FOREIGN

Burmah Oil Co., Ltd., of Glasgow, Scotland, is pressing reconstruction of the war-ravaged oil industry in Burma, including the rebuilding of its prewar 20,000 b/d refinery at Syriam. Scale of operations will be less than prewar throughput, but refinery is being rebuilt in such a manner that its capacity can be increased if and when additional oil resources are discovered. Company does not anticipate completion of program before 1951.

Anglo-Iranian Oil Co. in conjunction with Gulf Oil Corp. plans to construct a refinery with an eventual annual capacity of 30,400,000 bbls. (80-85,000 b/d) on the Isle of Grain at the Thames and Kedway estuaries in England. Refinery, cost of which is estimated at $120,000,000, will be built in stages, beginning with central refinery unit, to be followed by cracking and related units.

• • •

LEGISLATION

Water pollution control legislation passed by the last session of Congress was signed by President Truman—and is now Public Law 845. Among other provisions, it authorizes the Surgeon General of the Public Health Service to "bring suit on behalf of the United States to secure abatement" of a pollution of interstate waters under certain conditions, but only after "reasonable opportunity" has been afforded for correcting the situation.

• • •

TRANSITION

Sinclair has closed down its 5000 b/d refinery at Fort Worth, saying that the Fort Worth-Dallas market can be better served by the company's new product pipeline from Houston. Company said that its 75,000 b/d refinery at Houston is more efficient and flexible than Fort Worth operation.

Shell Chemical Corp. is moving its headquarters from San Francisco to New York in order to have its management operations closer to marketing centers. The company now sells 95% of its products east of the Rocky Mountains. Pacific Coast manufacturing and sales operations will not be affected.

Shell Chemical operates three plants in California —at Pittsburgh, Martinez and Wilmington—and others at Wood River, Ill., and Houston.

NOW! DYNALOG TEMPERATURE MEASUREMENT

with thermocouples or resistance bulbs

HIGH RANGES . . . LOW RANGES . . . IN BETWEEN— the unique advantages of Dynalog Electronic Instruments are adaptable to practically any process having temperatures to be measured, recorded, or controlled *exactly* and *fast*. Using either thermocouples or resistance bulbs, these instruments are unequalled in their flexibility of application—just as they are in their combination of accuracy, sensitivity, and speed of response.

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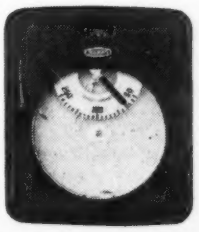
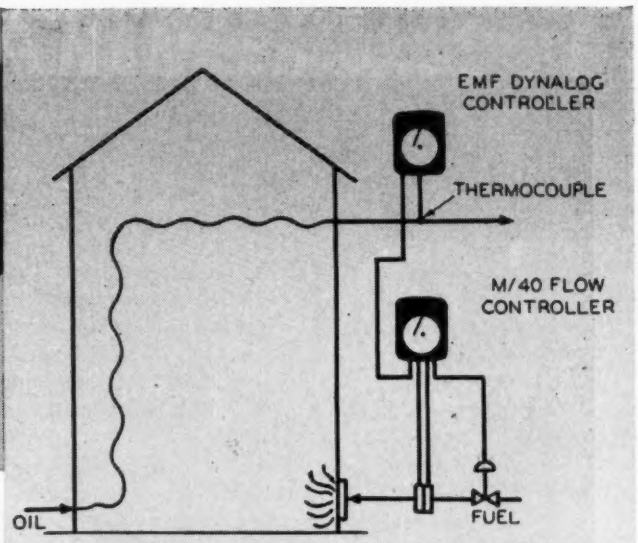
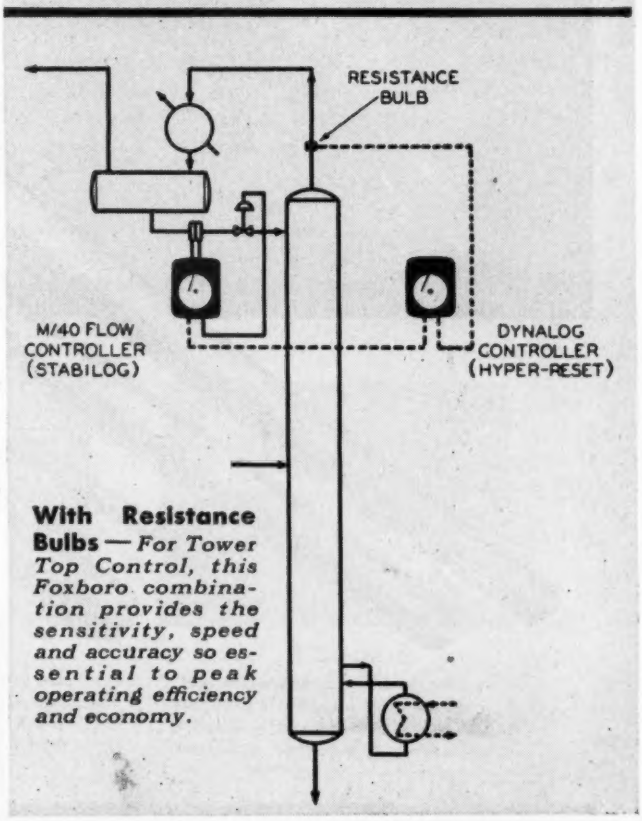




With Thermocouples—*On Pipe Stills, This Foxboro Combination assures extremely accurate, trouble-free control of transfer line temperatures under all conditions.*



With Resistance Bulbs — *For Tower Top Control, this Foxboro combination provides the sensitivity, speed and accuracy so essential to peak operating efficiency and economy.*

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⅔ the cost of Steel Tubes! ½ the cost of

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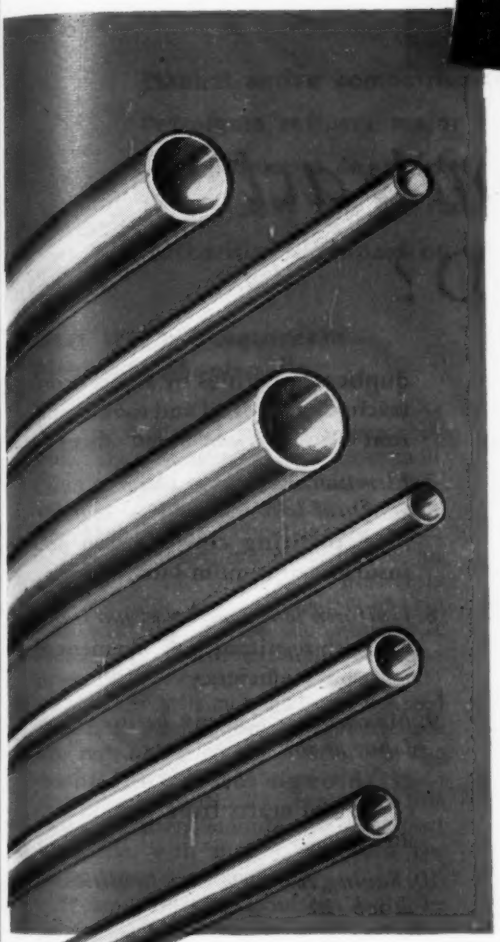
ALCOA ALUMINUM HEAT EXCHANGER TUBES



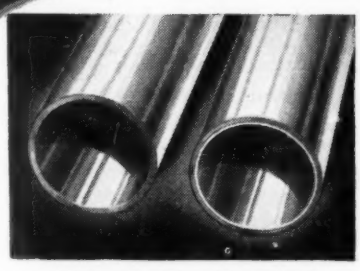
Even an average size refinery can save thousands of dollars a year retubing with aluminum heat exchanger tubes! They cost you less these days than any other tubes on the market . . . only ⅔ as much as cold-drawn seamless steel, ½ as much as copper or Admiralty, ⅙ as much as stainless steel or Monel. Add to these savings, the savings in maintenance and replacement that you get by using aluminum.

Aluminum tubes resist corrosive attack by sour crude, high-sulfur fractions, ammonia, and H_2S, even when mixed with CO_2. Refineries report as much as 18 years' service from aluminum heat exchanger tubes on sour crude installations.

For product-to-product exchangers, and with most fresh, cooling waters, you can install aluminum tubes in your present equipment where steel tube sheets are used. If the equipment has brass tube sheets, replace them with Alcoa Aluminum Tube Sheets for trouble-free service over long periods. Alcoa Aluminum Tubes in Alcoa Aluminum Tube Sheets give excellent service where either salt or fresh, cooling water is used.

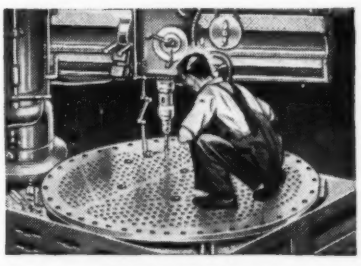
Immediate shipment of Alcoa Aluminum Heat Exchanger Tubes in all standard diameters and wall thicknesses from warehouse stocks in the mid-continent area. Other sections will receive prompt shipments from mill.

If your water or product conditions require it, our engineers will be glad to advise with you on the use of Alcoa Aluminum Tubes and Tube Sheets. For this service, or for engineering data and information, write to ALUMINUM COMPANY OF AMERICA, 1486 Gulf Bldg., Pittsburgh 19, Penna. Sales offices in 54 leading cities.



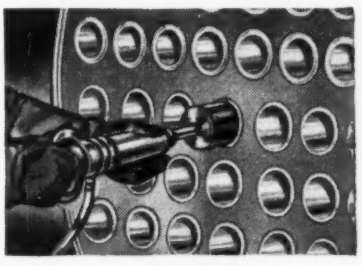
BARE OR ALCLAD TUBES

For product-to-product or treated water installations, bare Alcoa Aluminum Tubes will be entirely satisfactory. Where corrosive waters are to be handled, *Alclad* Aluminum Tubes should be used.



TUBE SHEETS

of Alcoa Aluminum are easy to drill and fabricate, light to handle, give excellent service with Alcoa Aluminum Tubes where either salt or fresh cooling waters are used.



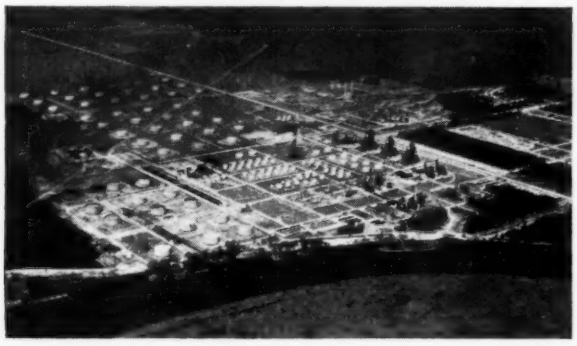
ROLL-IN

Your boilermakers will encounter no problems of rolling-in Alcoa Aluminum Tubes. Use standard tools and normal machining technique on aluminum.

HEAT EXCHANGER TUBES

ALCOA

ALUMINUM



The "Master" Contract – GOOD OR BAD?

EVEN before the last war, a definite trend seems to have been established which has become accelerated in recent years—in favor of the so-called "master" contract.

Under this type of contract *all* engineering and construction work to be undertaken at any particular refinery site is placed with *one* engineering contractor—instead of being distributed among several.

From our experience—in the building of complete domestic refineries at Denver, Lake Charles, Salt Lake City and currently at East Chicago, Indiana, plus complete foreign installations made in Palestine and currently contracted for in Brazil, Canada, Argentina and the British Isles—there *are* definite and direct advantages in this method of operation which are probably the reason for the increasing number of "master" contracts being let.

For instance, the "master" type contract offers to the refiner—big or small,

1. *Concentration of overall process responsibility*
   ... with consequent increase of efficiency of final plant and more profitable employment of refiner's own staff
2. *Integrated process planning*
   ... providing actual initial capital savings and continued improved operating efficiency
3. *Coordinated mechanical engineering*
   ... eliminating costly hours of coordinating time and job site alterations
4. *Uniformity of engineering specifications*
   ... providing economy in maintenance and spare parts inventory
5. *Centralized purchasing of materials and equipment*
   ... permits allotment of scarce materials in accord with desired completion schedule
6. *Simplified field administration and accounting*
   ... removing the necessity of duplicate facilities by several contractors in the field and the concurrent extra work at home offices
7. *Elimination of competition for local labor*
   ... expediting construction and insuring minimum labor costs
8. *Uniform labor policy at job site*
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by
Warren L. Smith
Vice President of The
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TOMORROW

. . . IN PETROLEUM TECHNOLOGY

Recent technological and economic developments discussed here in the light of their future bearing on petroleum refining operations include:

- **Ethanol active competitor in antifreeze market.**
- **Petroleum refiners major consumers of catalysts.**
- **New teamup a natural for synthetic liquid fuel research.**
- **Bibliography and translation exchanges established.**
- **Authorities far apart on synthetic fuels costs.**

Next Winter's Antifreeze Picture Is Shaping Up

UNLESS SOMETHING UNEXPECTED happens, it seems possible that active competition will again exist in the antifreeze market this coming winter. Due to other war and postwar chemical demands, it has been several years since an abundance of antifreeze materials was available, and the shadow of this past still falls across the picture. It seems certain, for example, that the production of glycol (permanent) antifreezes will not meet or exceed demands, and methanol antifreezes are not likely to be a drug on the market. However, ethanol antifreezes should be plentifully available this year and their manufacturers expect to battle with makers of both the other types of antifreezes.

If equitable distribution could be taken for granted—which it can't—price would be the key to the picture. Glycol antifreezes retail for $3.25-$3.50 per gallon, compared with ethanol at about $1.75 and methanol at $1.20-$1.35 a gallon (or slightly higher). Everything taken into consideration, one prediction[1] is that the three major antifreezes will be consumed in approximately equal quantities the coming season, with total sales of some 70,000,000 gallons, representing a gross of $125,000,000 or more.

D. G. Zink, formerly of U. S. Industrial Chemicals and now with the Stanolind Oil & Gas Co., reportedly[1] feels that "ethylene glycol should eventually become the leading antifreeze." Methanol, however, has merits of its own, chief of which will always be a considerable price advantage; it is a volatile-type antifreeze, incidentally.

Those motorists who prefer the permanent-type antifreezes because they have used them year after year, after addition of inhibitors, have probably not noted such recent information as the statement that "manufacturers claim that the varying rate of (corrosion inhibitor) breakdown and the possibility of contamination by exhaust gases from cylinder head leaks, etc., require that antifreeze material be utilized for only one season and not be reinhibited."[1] If this practice is followed, the permanent-type antifreezes may lose some of their aura of superiority, especially taken in combination with their occasional tendency to leak through pinholes and to form a "lacquer" on cylinder walls.

In any case, motorists this coming winter need not fear freeze-ups caused by anything other than their own tardiness in adding antifreeze. The permanent types will undoubtedly be sold on a first-come, first-served basis, as in the past, but the petroleum industry will not lose gasoline and lubricant sales because many cars are laid up by an antifreeze shortage.

Refining Industry Major Consumer of Catalysts

ACCORDING TO A RECENT SURVEY of the field of catalyst manufacture,[2] the petroleum industry is by all odds the nation's leading consumer of catalysts, a unique position when it is considered that 10 years ago catalytic processes—cracking, reforming, hydroforming, and so on—were generally held to be research curiosities of potential but not near-future importance.

In his estimates of major catalyst replacement requirements for 1948, Earl C. Ray of the Harshaw Chemical Co. shows a figure of 38,000 tons of silica-base catalysts for "synthetic cracking—all kinds," these catalysts being valued at $10,000,000. Next on the list is hydroforming, whose catalyst replacements are expected to total 1,800 tons (alumina-base type), valued at $3,200,000. Some 410 tons of catalyst (valued at $600,000) will be required for the dehydrogenation of butane and butylenes to produce butadiene, and the detailed figures wind up with an estimate of $250,000 worth of nickel catalysts (75 tons) for fat and oil hydrogenation. While this list does not include catalysts consumed in the manufacture of ammonia, methanol, and styrene, nor in the myriad catalytic processes employed by chemical manufacturers, it is significant indeed to note that the petroleum industry dominates the catalyst-consuming field to an overwhelming degree.

The above-mentioned survey[2] includes an interesting discussion of catalyst uses, types, and manufacturers, but these details are not germane to this particular discussion. It must suffice to note that the Houdry Process Corp., the M. W. Kellogg Co., the Oronite Chemical Co., and the Socony-Vacuum Oil Co. are among the makers as well as users of catalysts.

Gulf Oil and Koppers Combine For Synthetic Fuels Research

THE PETROLEUM AND COAL industries have noted with no great surprise the recent announcement of the signing of an agreement between the Gulf Oil Corp. and the Koppers Co. under which these two concerns will engage in cooperative research and development of processes for the conversion of coal to gas and liquid fuel.

Both companies are "Mellon" concerns, with headquarters in buildings across the street from each other in downtown Pittsburgh. Moreover, as the announcement points out, Koppers' research has been somewhat concentrated on methods for the conversion of coal to synthesis gas, while Gulf, more interested in the past in natural gas, an "easier" raw material, has probably concentrated its research on the synthesis step.

This combination parallels, in intent, the joining of forces, last year, of the Pittsburgh Consolidation Coal Co. and the Standard Oil Co. (N. J.), although the announced program of the latter, on paper at least, was far more specific and ambitious in scope. All that the Gulf-Koppers announcement states is that the agreement may lead to the establishment of pilot plant facilities to further the joint developments of laboratory research programs.

Both these combines, however, serve to highlight one or two perti-

(1) Anon., "Three Chemicals Compete for Antifreeze Market," *Chemical Industries* 62, No. 5, 764, 818, 820 (1948).

(2) Ray, E. C., "Catalyst Manufacture—A Growing Industry," *Chemical Engineering* 55, No. 5, 127-29 (1948).

nent facts of life in regard to synthetic liquid (and gaseous) fuels. First of all, natural gas supplies are far from inexhaustible, and coal appears to be the ultimate raw material from which to prepare synthetic fuels. Secondly, the Synthine process and its variants appear to have a decided economic edge over competing synthetic fuel processes. Thirdly, coal companies are not equipped to distribute and sell synthetic liquid fuels, while petroleum companies are unacquainted with the details of coal technology. Cooperation rather than unwarranted competition seems to be the watchword of the future in the synthetic fuels field. Finally, coal as a raw material may not be very far from a competitive position.

Bibliography and Translation Exchanges are Established

AS SMALL PETROLEUM COMPANIES know only too well, the cost of adequate information services comes high. Petroleum refining, with all its complexities, is too broad a field to be reckoned with adequately by small libraries and one or two men, yet the very diversity of the industry constitutes all the more reason for the continued need for technical information.

This broad subject was considered elsewhere in some detail last year,[3] so that further comment here would be unwarranted. However, it is certainly encouraging to note that several information aids have recently been made generally available by various societies and that these services ought to be of growing value when more groups participate in them.

Within the past two months, the Science-Technology Group of the Special Libraries Association has announced both a bibliography pool and a card index of technical translations. The former service is concerned specifically with *unpublished* bibliographies, which are deposited with the Pool and then made available by it, gratis, on a loan basis.

Of the 50-odd bibliographies collected to give the Pool its start, several are of direct interest to petroleum refiners: (1) patents on degreasing of metals, 1925-1942; (2) fuel injection in spark-ignition Otto cycle engines, 1930-1943; (3) carburetors and carburation, 1919-1944; (4) combustion, 1927-1944; (5) combustion studies in internal combustion engines, 1929-1945; and (6) U. S. patents on antifreezes, up to September, 1937.

It may well be expected that many other pertinent bibliographies will be added to those already available, especially if all who have unpublished bibliographies available will deposit copies with this group. Deposits and requests for loans should be addressed to Mr. Ralph H. Hopp, Technical Librarian, Battelle Memorial Institute, Columbus 1, Ohio.

In the words of *Chemical and Engineering news,*[4] "translating costs for many scientific and technical articles and reports in foreign journals can be eliminated by the use of a 'union card index of technical translations' compiled and serviced free of charge" by the aforementioned group. "A master card file records translations in the fields of engineering, materials, aeronautics, chemistry, metallurgy, communications, *petroleum,* and technology." Contributing agencies include the Office of Technical Services and the American Documentation Institute, while many private industrial firms are said to have "contributed data on translations in their files."

Unlike its methods in the bibliography service, where a pool of deposited documents actually exists, the Special Libraries Association, in this case, simply acts as a clearing house, supplying inquirers with the names of companies or groups which have the desired translations, as noted in its index file. "To provide for organizations not wishing to reveal their interests through disclosing translations in their files, however, the service will act as exchange intermediary for the loan or sale, keeping the firm names anonymous. All inquiries should be addressed to Miss Miriam Landuyt, Research Librarian, Caterpillar Tractor Co., Peoria 8, Ill.

Without freely available technical information, petroleum refining advances would be few and far between. It certainly behooves all concerned to cooperate with those groups which are trying to make its distribution easier and less expensive.

Authorities Far Apart On Synthetic Fuels Costs

MANY OTHERS WHO are following developments in the synthetic liquid fuels program can sympathize with the confusion experienced by the Special Subcommittee on Petroleum of the House Committee on Armed Services. It stated in a recent report:

"Only an experienced scientist could evaluate this information (obtained at its hearings) and, judging from the different views we have received, the conclusions of even an experienced scientist would be widely disputed at this time".

Some of this apparent confusion, at least as regards cost figures, is quite evident in two recent papers on the general subject, one by the president of Standard Oil Development Co., E. V. Murphree,[5] and the other by the chief of the Office of Synthetic Liquid Fuels of the Bureau of Mines, W. C. Schroeder.[6] Both papers contain figures which should be the "last words" on the subject, considering the eminent positions of their writers, yet on such methods as the Synthine process using natural gas Schroeder states that "talk of gasoline produced at 7 to 9c per gal." is the most recent estimate (for production from natural gas at 5c per 1000 cu. ft.), while Murphree's figures, converted to the same raw material cost basis, yield an estimate of 11.4c per gal. Careful analysis of the bases of both statements yields a closer agreement—Murphree's, for example, is for "a gasoline of higher antiknock quality than present premium gasoline." However, only experts in the economics of the field can correlate the meanings and nuances of all the figures presented on all processes, which means that each such paper must be very carefully read if it is to be properly evaluated.

These comments are not offered in criticism of the very real purpose served by such papers—the presentation to the public of the latest economic data available to those in a position to know. They are meant only as a reminder that: (1) all is not clear—much remains to be determined, (2) any cost and investment figures are subject to rapid invalidation in these days of changing dollar values—the passage of nine months can render "undependable" the best estimates available and (3) in many cases—and quite honestly and reasonably justifiably—the viewpoints of the writers are reflected in their use and interpretation of the data at hand. Nevertheless, without such papers, no one but those in a position of trust inside each company would possess any reliable information for comparison with data released by public agencies.

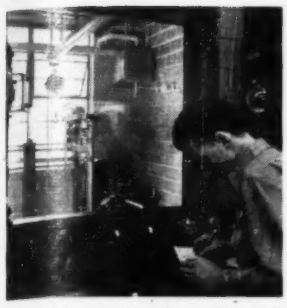
In the meantime, more is becoming known about the technical processes which lie behind the cost and investment figures. Various publications of the Office of Technical Services, for example, are yielding valuable insight into German research on phases of potental significance to domestic operations.

(3) Weil, B. H., *Information Service and the Petroleum Industry,* Georgia Institute of Technology, State Engineering Experiment Station Circular No. 10, 1947. 3 pages.

(4) Anon., "Card Index of Technical Translations," *Chemical and Engineering News* 26, No. 26, 1931 (1948).

(5) Murphree, E. V., "Natural Gas, Coal, Oil Shale as Sources of Liquid Fuels," *Oil and Gas Journal* 46, No. 49, 66, 68-70, 95 (1948).

(6) Schroeder, W. C., "Comparison of Major Processes for Synthetic Liquid Fuels," *Chemical Industries* 62, No. 4, 574-77, 682 (1948).



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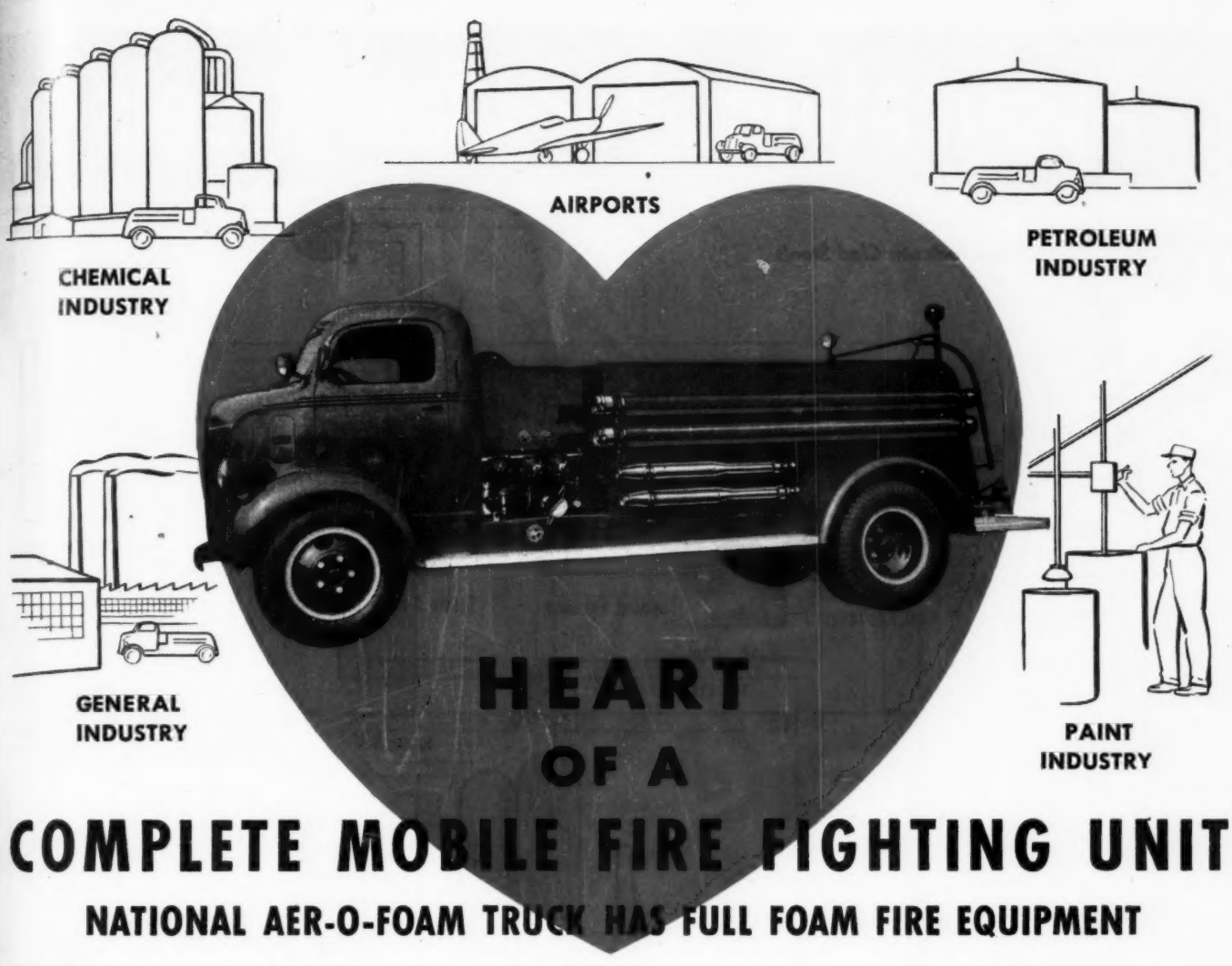

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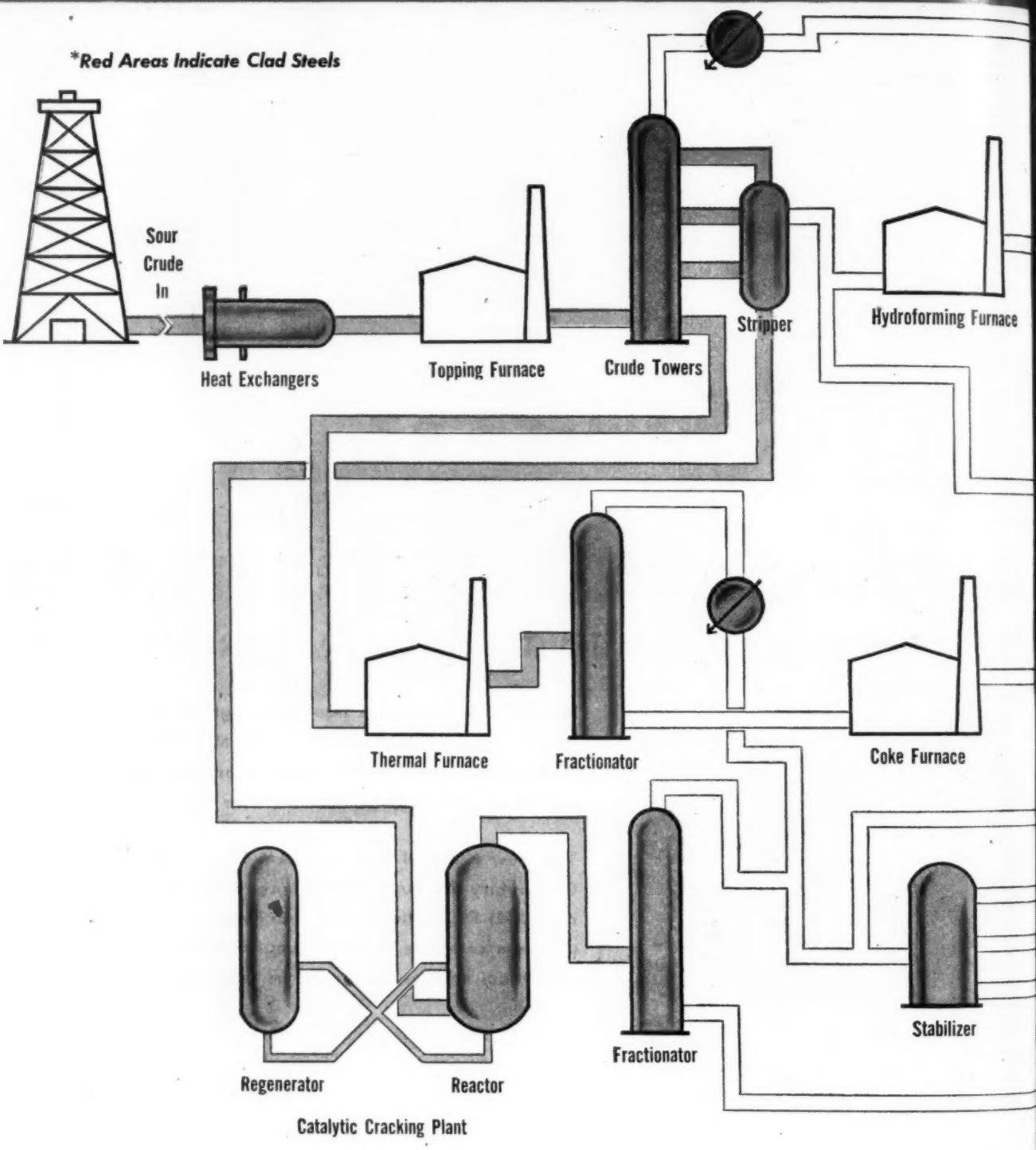

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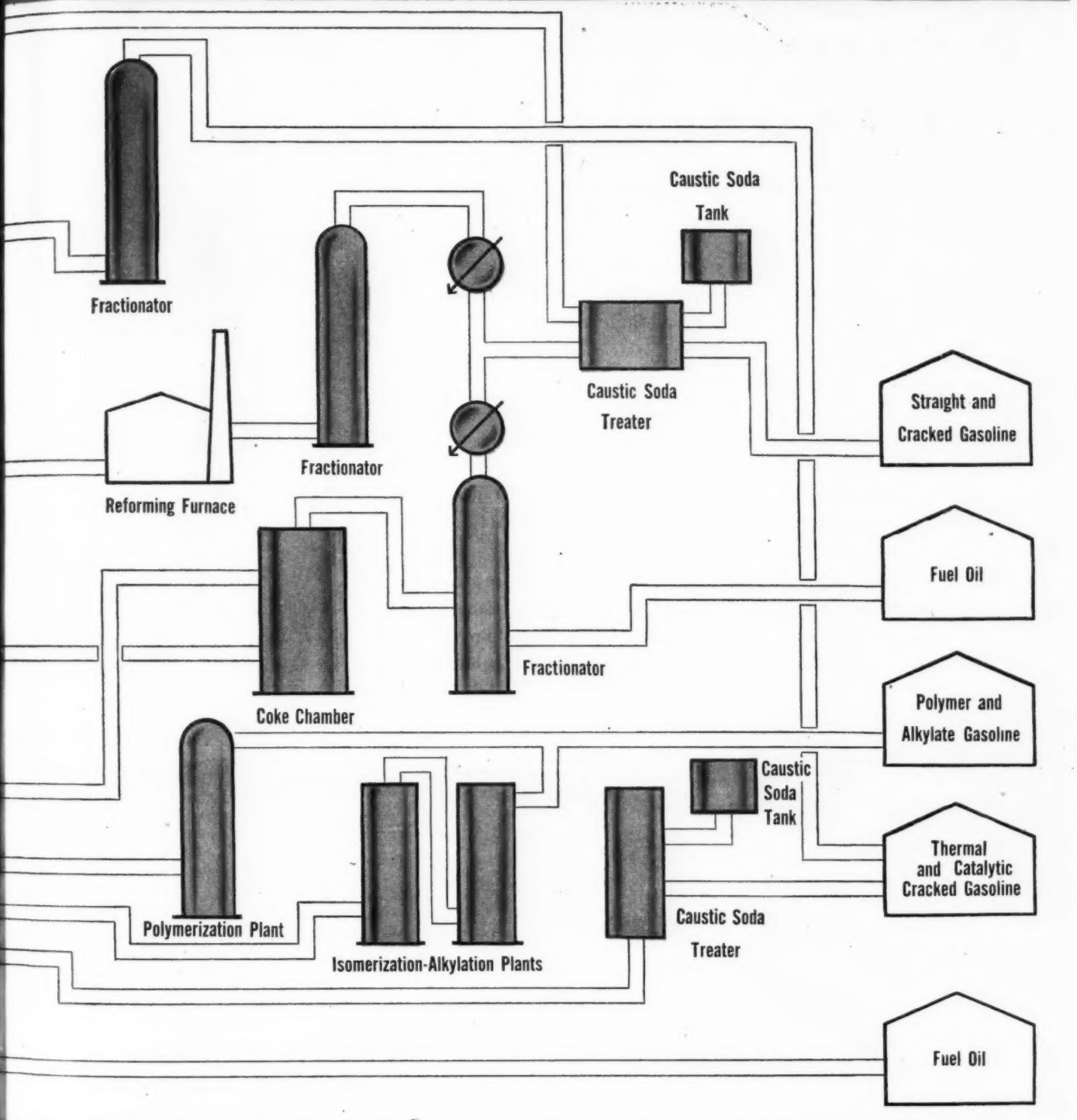

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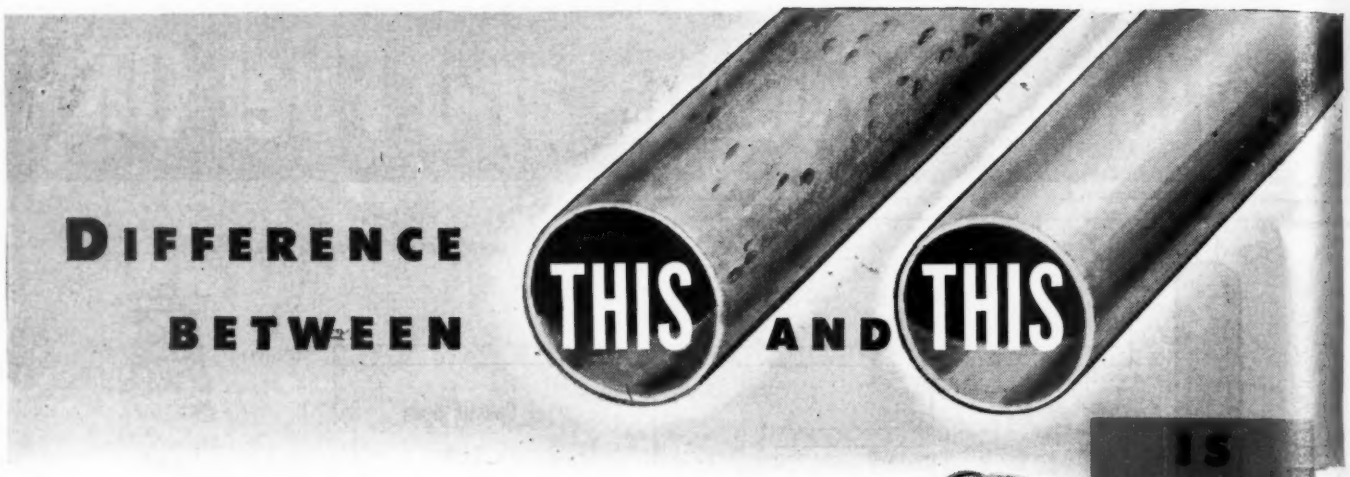

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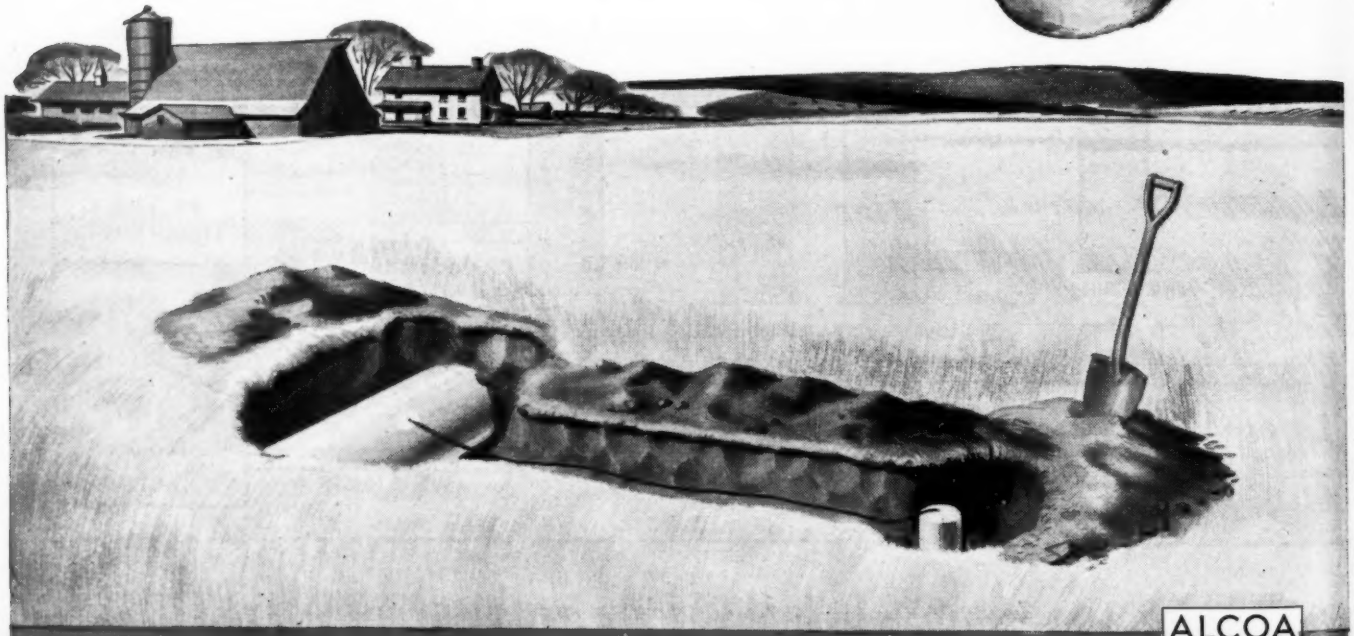

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Viscosity at 100° F., S.U.S.	41
Solidification Temperature, ° F	—20

No. 6 Antioxidant No. 6 is a solution containing 50% Iso-butyl-para-aminophenol, 30% Anhydrous iso-propanol, and 20% Anhydrous methanol.

PROPERTIES

Specific Gravity at 60°/60° F.	0.91
Pounds per Gallon at 60° F	7.57
Flash Point (Tag C.C.) ° F	60
Viscosity at 100° F., S.U.S.	41
Solidification Temperature, ° F	0

No. 22 Antioxidant No. 22 is a commercial grade of N:N'-disecondary butyl-para-phenylene-diamine containing no solvents.

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Flash Point (C.O.C.) ° F	290
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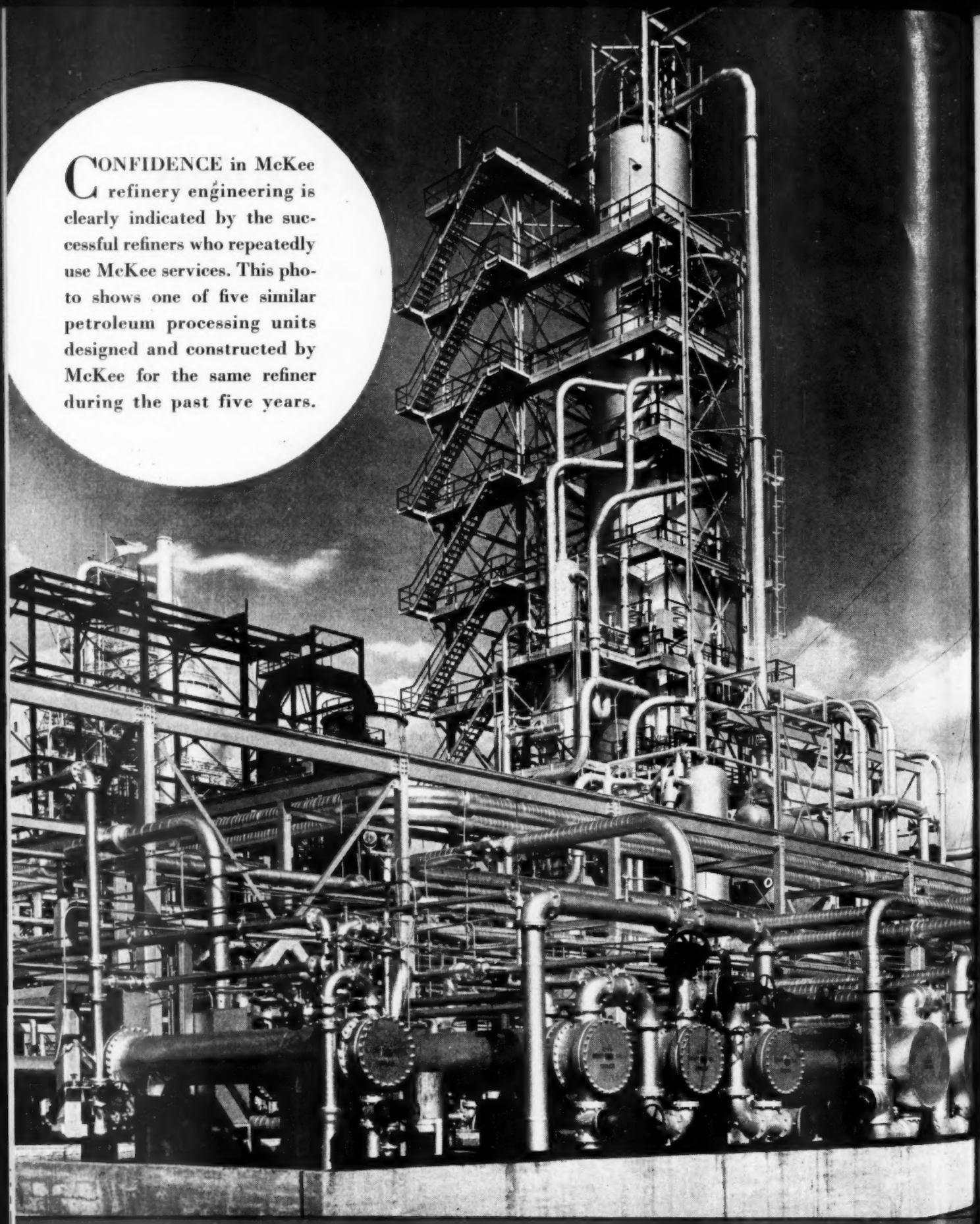

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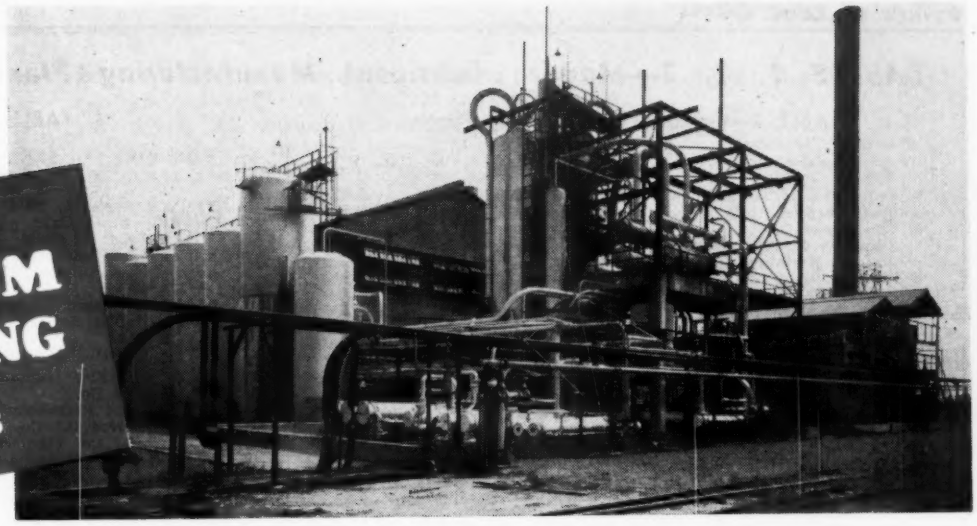

Modern MEK solvent dewaxing plant at Sinclair's Houston refinery

The OUTLOOK for LUBE OILS

By E. R. SMOLEY
The Lummus Co., New York

Solvent refining and solvent dewaxing lubricating oil plants both operating and under construction are listed with estimated capacities. Total lubricating oil production is given through 1947 and estimated available production given through 1951 for both this country and the rest of the world. The demand picture is discussed as based on several factors and it is concluded that there is no indication that world demand for lubricating oils will be completely met in the future even with the large number of plants now under construction.

WHEN the refiner looks into the future of lubricating oils, he is interested in what quantities he must produce as well as what quality changes he must anticipate. Today premium lube oil blending stocks are solvent refined and dewaxed to as high as 95-100 Viscosity Index and zero or lower pour point. Additives are blended with these stocks for imparting additional qualities. Synthetic organic lube oils were made and used during World War II.

Mineral oils from petroleum have been used successfully for lubricating machinery from as far back as the beginning of the Christian era. They were originally the crude oil and later the distilled raw lube stocks. This was followed by acid treating, cold wax settling and other processes developed by the refining industry. Modern solvent refining and dewaxing were introduced commercially less than 20 years ago and made possible the production of 85 V.I. or better oils with 0° to 20° F. pour point from practically any crude source.

The use of raw stocks from less desirable crudes has been increasing of necessity, and the replacement of plants producing lower quality lubes by modern solvent refining installations still continues. It is believed that the lubricating oil blending stocks produced by these modern methods will require no major improvement in quality to satisfy future premium lube oil requirements.

The improvement in the quality of lube oils by the use of additives has represented a real development in this field. They reduce wearing of metals, formation of lacquer and varnish deposits, sludging, oxidation, etc.; increase oiliness and Viscosity Index, reduce pour point and supply detergency. Considerable research is still being carried out in this field and it is expected that further developments and improvements in the continued future use of additives will result. No major change is anticipated, however, in the present basic methods of manufacture of premium lubes, i.e. the use of a fractional percent of additives to refined lube blending stocks.

Synthetic organic lube oils were produced and used during the war and demonstrated special qualities, such as extremely high Viscosity Index and very low pour point. These oils are very expensive and it seems fairly certain their use will be limited to special applications such as for fine, sensitive machines, airplane engines exposed to very low temperatures, sealed in lubrication, and fluid drive mechanisms.

It is, therefore, fairly evident that the present modern refining equipment will continue to supply the future quality demands for lube oils and that any predictions of production and consumption quantities based on present type solvent refining and dewaxing plants will represent a true future picture.

Modern Plant Facilities

Modern lubricating oil manufacturing facilities are not as simple as in the old days but they give increased yields of higher quality products. A typical plant for processing reduced crude for full production of premium grade lubes, 95 V.I. and zero pour, includes a vacuum distillation unit, propane deasphalting plant, single solvent refining unit, solvent dewaxing plant and a clay finishing unit. The higher the quality of the lube oil produced, that is the higher the V.I. and the lower the pour point, the lower the yield of finished lube oils obtained.

Projected production figures, therefore, on the basis of new plants being installed will be lower if yet higher quality oils are demanded. It is also difficult to estimate from new

TABLES 1, 2, 3—Modern Lubricant Manufacturing Plants Built and Building

TABLE 1—Propane Deasphalting Plants

Refinery	Location and Est. Chg. Cap., B/D	
1. Union Oil Co. of Calif.	Oleum, Calif.	2,000
2. Shell Petroleum Co.	Wood River, Ill.	3,300
3. The Texas Co.	Port Arthur, Texas	1,960
4. Standard Oil Co. (Indiana)	Whiting, Indiana	1,200
5. Kendall Refining Co.	Bradford, Pa.	900
6. Humble Oil & Refining Co.	Baytown, Texas	4,800
7. Bradford Penn. Refining Co.	Warren, Pa.	250
8. Esso Standard Oil Co.	Baton Rouge, La.	2,100
9. Sinclair Refining Co.	Houston, Texas	3,500
10. Mid-Continent Petroleum Corp.	Tulsa, Okla.	2,000
11. Atlantic Refining Co.	Philadelphia, Pa.	4,000
12.*The Pure Oil Co.	Smiths Bluff, Texas	4,200
13.*Sinclair Refining Co.	E. Chicago, Indiana	5,100
14.*Shell Oil Co.	Houston, Texas	6,000
15.*Phillips Petroleum Co.	Kansas City, Mo.	2,000
16.*Tide Water Associated Oil Co.	Bayonne, N. J.	4,000
17.*Standard Oil Co. (Indiana)	Whiting, Indiana	3,000
18.*Creole Petroleum Corp.	Venezuela	2,000
19.*Shell Oil Co.	Cardon, Venezuela	3,500
20.*Consolidated Refineries, Ltd.	Haifa, Palestine	7,000
21.*Anglo Iranian Oil Co.	Llandarcy, S. Wales	2,000
22.*Comp. Espanola de Petroleo S.A.	Tenerife, Canary Isl.	700
23.*Standard Oil Co. of Ohio	Toledo, Ohio	2,500
24.*The Texas Co.	Port Arthur, Texas	6,000
	Total	74,010

* Under construction.

TABLE 2—Solvent Extraction Plants

Furfural Process

1. Gulf Oil Corp.	Port Arthur, Texas	6,000
2. The Texas Co.	Lawrenceville, Ill.	2,400
3. The Texas Co. (3)	Port Arthur, Texas	10,000
4. The Texas Co.	Los Angeles, Cal.	3,500
5. Magnolia Petroleum Co.	Beaumont, Texas	3,200
6. Shell Oil Co.	Martinez, Calif.	3,250
7. Quaker State Refining Co.	Farmer's Valley, Pa.	1,700
8. Quaker State Refining Co.	St. Mary's, W. Va.	600
9. Quaker State Refining Co.	Emlenton, Pa.	1,700
10. Continental Oil Co.	Ponca City, Okla.	1,500
11. Golden Bear Oil Co.	Bakersfield, Calif.	500
12. British American Oil Co. Ltd.	Clarkson, Ont., Can.	2,000
13. Shell Refineries, Ltd.	Shell Haven, England	1,650
14. Trinidad Leaseholds, Ltd.	Point-A-Pierre, Trin.	2,910
15. Gewerkshaft "Nerag"	Hanover, Germany	3,000
16. Cooperative Refinery Assoc.	Coffeyville, Kansas	2,000
17.*Socony-Vacuum Oil Co. Inc.	Paulsboro, N. J.	3,000
18.*Magnolia Petroleum Co.	Beaumont, Texas	4,000
19.*Tide Water Assoc. Oil Co.	Bayonne, N. J.	5,000
20. Sun Oil Co.	Marcus Hook, Pa.	2,000
21.*Consolidated Refineries Ltd. (2)	Haifa, Palestine	10,000
22.*Anglo-Iranian Oil Co.	Abadan, Iran	1,500
23.*Cit-Con Oil Corp.	Lake Charles, La.	8,000
24.*Anglo-Iranian Oil Co.	Llandarcy, S. Wales	1,400
25.*Comp. Espanola de Petroleo S.A.	Tenerife, Canary Isl.	900
26.*Shell Oil Co.	Cardon, Venezuela	6,000
27.*Societe General Huiles de Petrole	Dunkirk, France	2,000
28.*Burmah Oil Co.	Syriam, Burma	1,450
29.*Standard Oil Co. of Ohio	Toledo, Ohio	5,000
30.*The Texas Co.	Port Arthur, Texas	5,000
	Total	101,160

Phenol Process

1. Kendall Refining Co.	Bradford, Pa.	1,400
2. Imperial Oil Co.	Sarnia, Canada	2,500
3. Esso Standard Oil Co.	Bayonne, N. J.	1,750
4. Esso Standard Oil Co. (2)	Baton Rouge, La.	7,000
5. Standard Oil Co. of Calif.	Richmond, Calif.	3,500
6. International Petroleum Co.	Colombia	300
7. Humble Oil & Refining Co.	Baytown, Texas	8,000
8. Union Oil Co. of Calif.	Oleum, Calif.	2,000
9. Sinclair Refining Co.	Houston, Texas	4,000
10. Gulf Oil Corp.	Port Arthur, Texas	3,100
11.*Sinclair Refining Co.	East Chicago, Ind.	6,000
12.*Shell Oil Co.	Houston, Texas	5,500
13.*Atlantic Refining Co.	Philadelphia, Pa.	3,000
14.*Phillips Petroleum Co.	Kansas City, Mo.	4,000
15.*Standard Oil Co. (Indiana)	Whiting, Ind.	6,000
16.*The Pure Oil Co.	Smiths Bluff, Texas	4,800
17.*Creole Petroleum Co.	Venezuela	2,000
	Total	64,850

Duosol Process

1. Socony-Vacuum Oil Co.	Paulsboro, N. J.	3,000
2. Magnolia Petroleum Co.	Beaumont, Texas	2,800
3. Gulf Oil Corp.	Girard Point, Pa.	2,500
4. Shell Refining Co.	Stanlow, England	2,000
5. Shell Petroleum Corp.	Wood River, Ill.	3,000
6. Standard Oil Co. of Calif.	Richmond, Calif.	8,500
7. Continental Oil Co.	Ponca City, Okla.	1,800
8. Sun Oil Company	Marcus Hook, Pa.	5,000
9. Champlin Refining Co.	Enid, Okla.	1,200
10. Attock Oil Co.	Rawalpindi, India	500
11.*Cit-Con Oil Corporation	Lake Charles, La.	7,200
12. *Union Oil Co.	Oleum, Cal.	2,500
	Total	40,000

TABLE 2—(Continued)

Refinery	Location and Est. Chg Cap. B/D	
SO_2-Benzol Process		
1. Tide Water Assoc. Oil Co.	Avon, Calif.	1,500
2. Shell Oil Co. of Calif.	Martinez, Calif.	1,500
3. Union Oil Co. of Calif.	Oleum, Calif.	1,500
4. Lobites Oil Fields, Ltd.	Ellesmereport, Eng.	350
5. Anglo-Iranian Oil Co.	Llandarcy, S. Wales	1,600
6. The Texas Co.	Port Arthur, Texas	1,000
7. Tide Water Assoc. Oil Co.	Bayonne, N. J.	2,600
8. Manchester Oil Refinery	Manchester, England	700
	Total	10,300
Chlorex Process		
1. Standard Oil Co. (Indiana)	Wood River, Ill.	1,000
2. The Pennzoil Co.	Rouseville, Pa.	1,000
3. Mid-Continent Petroleum Corp.	Tulsa, Okla.	900
4. Socony-Vacuum Oil Co. Inc.	Olean, N. Y.	1,700
5. Standard Oil Co. (Indiana)	Casper, Wyoming	600
6. Bradford Penn. Refining Co.	Clarendon, Pa.	500
	Total	5,700
Nitrobenzene Process		
1. Atlantic Refining Co.	Philadelphia, Pa.	2,350
2.†Sinclair Refining Co.	Wellsville, N. Y.	800
	Total	3,150
†Nitrobenzene-Sulfuric acid	Total solvent refining	225,160

TABLE 3—Solvent Dewaxing Plants

MEK-Benzol Process

1. The Texas Company	Lawrenceville, Ill.	1,400
2. Atlantic Refining Co.	Philadelphia, Pa.	600
3. Gulf Oil Corp.	Port Arthur, Texas	1,500
4. Socony-Vacuum Oil Co., Inc.	Paulsboro, N. J.	3,800
5. The Texas Co. (2)	Port Arthur, Texas	5,000
6. Socony-Vacuum Oil Co., Inc.	Olean, N. Y.	2,850
7. Quaker State Refining Co.	Farmers Valley, Pa.	1,800
8. Magnolia Petroleum Co.	Beaumont, Texas	3,400
9. Tide Water Assoc. Oil Co.	Bayonne, N. J.	1,200
10. Standard Oil Co. of Calif.(2)	Richmond, Calif.	5,500
11. Sinclair Refining Co.	Wellsville, N. Y.	4,500
12. Continental Oil Co.	Ponca City, Okla.	1,300
13. Sinclair Refining Co.	Houston, Texas	3,500
14. Quaker State Refining Co.	Emlenton, Pa.	1,200
15. British American Oil Co. Ltd.	Clarkson, Ont., Can.	1,600
16. Sun Oil Co.	Marcus Hook, Pa.	3,500
17. Gulf Oil Corp.	Port Arthur, Texas	2,200
18. Petrolite Corp.	Kilgore, Texas	100
19. Shell Refineries, Ltd.	Shell Haven, England	1,600
20. Attock Oil Co. Ltd.	Rawalpindi, Pakistan	450
21. Shell Refineries, Ltd.	Stanlow, England	1,300
22. The Pennzoil Co.	Oil City, Pa.	3,000
23. Gewerkshaft "Nerag"	Hanover, Germany	1,800
24. Imperial Oil Co.	Sarnia, Ontario	2,500
25. U.S.S.R.	Russia	1,800
26. Atlantic Refining Co.	Philadelphia, Pa.	3,500
27. Humble Oil & Refining Co.	Baytown, Texas	4,500
28.*Sinclair Refining Co.	East Chicago, Ind.	5,200
29.*Shell Oil Co.	Houston, Texas	4,800
30.*Pure Oil Co.	Smiths Bluff, Texas	4,200
31.*Socony-Vacuum Oil Co.	Paulsboro, N. J.	3,000
32.*Magnolia Petroleum Co.	Beaumont, Texas	4,800
33.*Esso Standard Oil Co.	Baton Rouge, La.	4,500
34.*Sun Oil Co.	Marcus Hook, Pa.	2,000
35.*Tide Water Assoc. Oil Co.	Bayonne, N. J.	1,500
36.*Consolidated Refineries Ltd. (2)	Haifa, Palestine	7,500
37.*Anglo-Iranian Oil Co.	Abadan, Iran	1,000
38.*Cit-Con Oil Corp. (2)	Lake Charles, La.	7,500
39.*Anglo-Iranian Oil Co.	Llandarcy, S. Wales	1,000
40.*Burmah Oil Co.	Syriam, Burma	3,500
41.*Comp. Espanola de Petroleo S.A.	Tenerife, Canary Isl.	700
42.*Cooperative Refinery Assoc.	Coffeyville, Kansas	2,000
43.*Internation Waxes Ltd.	Agincourt, Ontario	150
44.*Societe Generale Huiles de Petrole	Dunkirk, France	1,500
45.*Esso Standard Oil Co.	Bayonne, N. J.	7,500
46.*Standard Oil Co. of Ohio	Toledo, Ohio	3,600
47.*Sun Chemical Co.	Chanute, Kansas	100
48.*Shell Oil Co.	Cardon, Venezuela	4,000
49.*Standard Oil Co. of Calif.	Richmond, Calif.	1,500
50.*The Texas Company	Port Arthur, Texas	8,750
	Total	145,600

Propane Dewaxing Process

1. Standard Oil Co. (Indiana)	Wood River, Ill.	1,300
2. Union Oil Co. of Calif.	Oleum, Calif.	1,300
3. Shell Petroleum Co.	Wood River, Ill.	3,600
4. Kendall Refining Co.	Bradford, Pa.	1,200
5. Humble Oil & Refining Co.	Baytown, Texas	3,700
6. Esso Standard Oil Co.	Baton Rouge, La.	2,200
7.*Phillips Petroleum Co.	Kansas City, Mo.	3,000
8.*Standard Oil Co. (Indiana)	Whiting, Indiana	4,000
9.*Creole Petroleum Corp.	Venezuela	600
	Total	20,900

SO_2-Benzol Dewaxing Process

1. Anglo-Iranian Oil Co.	Llandarcy, S. Wales	1,600
2. Lobitos Oil Fields Ltd.	Ellesmereport, England	350
3. Manchester Oil Refinery	Manchester, England	450
	Total	2,400

Barisol Process

1. Esso Standard Oil Co.	Baton Rouge, La.	1,800
2. Continental Oil Co.	Ponca City, Okla.	400
	Total	2,200
	Total dewaxing	171,100

lube facilities the quantity which replaces lubes already being manufactured of lower quality and the amount which represents new lube oils. The accompanying tables, however, are a good indication of increased lube oil production from plants now under construction both in the U. S. and outside this country.

Table 1 shows the 11 existing propane deasphalting plants and the 13 plants now under construction with a total charge capacity of approximately 74,000 b/d. The propane to oil ratio averages about 8 to 1. If we assume an average yield of 40% deasphalted oil, the production of heavy raw lube stock amounts to 29,600 b/d. The tables give for each plant the company, location and estimated average daily charge oil capacity.

Table 2 lists the 19 operating furfural refining units, and the 14 units now under construction with a total charge oil capacity of 101,160 b/d. At an average of 3 to 1 furfural to oil ratio, the furfural circulated would be over 300,000 b/d. If we assume an average yield of 75% raffinate, the average waxy refined lube stocks would amount to 76,000 b/d. This table lists for each plant the company, location and average daily oil charge capacity. Table 2 also lists the 11 operating phenol extraction plants and the 7 now under construction with a total charge capacity of 64,850 b/d. The company, location and daily oil charge capacity for each plant are also given in this table.

The other solvent extraction plants now operating and under construction are also listed under DuoSol, SO_2-Benzol, Chlorex and Nitrobenzene Processes with similar information as given under furfural and phenol. The overall total daily oil charge capacity to all solvent refining units is 225,160 b/d and a 75% yield would net 169,000 b/d of waxy solvent refined lube stocks.

A more significant indication of finished lube oils is the output from solvent dewaxing plants, as this is normally the final processing step other than clay finishing. The final clay finishing gives an average yield of 95-98%. Table 3, therefore, is the most significant indication of finished lube production. This table lists the 29 operating solvent (Ketone-Benzol) dewaxing plants and the 26 units now under construction with an average daily charge oil capacity of about 150,000 b/d.

With an average pressed oil yield of 80%, the finished solvent refined, solvent dewaxed oil production from MEK units would be 120,000 b/d. Similarly, the dewaxing plants now operating and under construction using Propane, SO_2-Benzol, and Barisol are listed in this table, and for all processes the company, location and daily average oil charge capacity are given. The overall total daily oil charge capacity to all dewaxing units amounts to about 175,000 b/d, and at 80% average yield the output would be about 140,000 b/d.

To finished solvent refined, dewaxed, clay contacted lubes must be added inhibitors and additives which are used to improve the quality of lube oils by eliminating corrosion, lacquer and varnish formation, sludging, offering resistance to oxidation, adding oiliness, permitting use of pressure between metal parts, increasing viscosity index, reducing pour, etc. The loss of yield, therefore, in clay finishing is approximately compensated by the addition of inhibitors and additives for obtaining total finished lube oil production.

Total lube production in the United States by years from 1938 to 1947 excluding 1939 based on Bureau of Mines figures[2] is given in Table 4.

The figures showing production capacity available built up for 1948 through 1951 based on new lube plants under construction in the U. S. are given in Table 5. It is fully realized that increased quality demands would reduce these figures and also that replacement lubes and new lubes from plants now under construction are difficult to estimate accurately.

The estimates for lube production outside the U. S. are more difficult. Bureau of Mines[3] supplies 1938 and 1946 lube production for all countries outside the U. S. as given in Table 6.

Estimates are made in this table for total production capacity available for the years 1947-1951 inclusive. Since U.S.S.R. figures are quite uncertain, the above estimates assume about 25,000 b/d for each of these years. There is probably no doubt that they will rebuild and expand some of the plants which were built prior to the war and the above figures are probably low. The rest of the production available capacity increase estimates are based on new lube plant capacity now under construction or being projected outside the U. S. The world total estimated lube available production figures, including the U. S. total, is 255,000 b/d for 1951. These estimates are all dependent on a peaceful cooperative world economy with increasing industrial activity, trade and gradual building up of the scale of living in Europe, South America and the Far East. This gives a rough picture of what the world has produced, is producing and can produce to lubricate the wheels of industry, railroads, automobiles, farm tractors, and so on. Now let us look at the demand picture.

TABLE 4—Total Lube Production in U. S.

Year	B/D Produced
1938	84,500
1940	103,400
1941	111,500
1942	108,900
1943	109,500
1944	115,800
1945	118,300
1946	128,900
1947	146,000

TABLE 5—Estimated U. S. Lube Production Capacity Available, 1948-1951

Year	Capacity B/D
1948	155,000
1949	173,000
1950	185,000
1951	195,000

Anticipated Demand

Lube oil demands prior to World War II paralleled the rate of increased consumption of fuels for automotive and industrial purposes. The Bureau of Mines figures[3] for production of lube oils show for 1938 a world total of 143,600 b/d with 84,500 b/d produced in U.S.A. Similar Bureau of Mines figures[2] show a breakdown of U. S. demands for lubes for 1938 to be 40% for automotive uses, 32% for industrial and 28% for export.

World lube consumption figures were studied by Garfias, Whitsel and Ristori[4] for 1938 and 1939 which showed consumptions of over 95,000 b/d in all countries outside the U. S. These figures showing world lube consumptions up to 164,000 b/d are given in Table 7.

Since over 40% of U. S. lube production goes to lubricate automobiles, it is of interest to look into this field first. The distribution of the use of gasoline gives an indication of where the lubes are used. The De-

TABLE 6—Lube Production Outside U. S., B/D

	1938	1946	1947	1948	1949	1950	1951
N.W.I.	6,000	3,800					
South America	1,300	300					
France	4,400	1,000					
Germany	3,000	1,100					
Italy	1,700	.....					
Roumania	1,300	2,000					
United Kingdom	2,800	6,400					
U.S.S.R.	27,000	21,000					
Burma	300	.....					
Japan	6,000	800					
Others	4,700	5,700					
Total—Outside U.S.	59,100	42,100	42,000	42,000	46,000	50,000	60,000
Total—Incl. U. S.	143,600	167,100	188,000	197,000	219,000	235,000	255,000

TABLE 7—World Consumption of Lube Oils, B/D

	1938	1939
United States	58,000	69,000
Outside U.S. (Produced outside)	62,000	63,000
Outside U.S. (Exported from U.S.)	36,000	32,000
Outside U.S. (Total)	98,000	95,000
World Total	156,000	164,000

partment of Commerce[5] tells us that gasoline is consumed 64.5% by passenger cars, 21.6% by trucks and the balance by buses, tractors, military and miscellaneous, including export. The passenger cars, therefore, consume the greatest bulk of gasoline and, therefore, lube oils.

At the end of 1946 there were 28.1 million passenger cars registered. Roughly 4 million cars were produced in 1947, over 5 million will be produced in 1948 barring a major work stoppage in one of the three big companies or several of the smaller ones. Half of this production was accomplished in the first half of this year even with a 17-day shutdown in Chrysler plants, two weeks or more in all G.M. plants and the stopping of Ford production for model change-overs.

39,000,000 Cars in 1950

Estimating 5 million cars in 1948, 1949 and 1950 there would be at the end of 1950 47 million passenger cars not allowing for old car scrapping. If it is assumed that 2 million cars will be scrapped per year for these four years, the 1950 year end registration would reach 39 million cars. The number of cars scrapped is apt to be higher than during an average period since the average age of cars is about 10 years as compared with a prewar age of about seven years.

Gasoline consumption per passenger car is of importance since lube oil consumption follows in more or less direct proportion. This consumption has risen from about 10 bbls. per car in 1925 to 15.33 barrels in 1941 and to 16.5 in 1946 according to the Bureau of Mines.[5] The gradual trend towards increased consumption per passenger car will no doubt continue because the American public still likes larger cars, likes to drive faster and more comfortably, and has an increased desire to travel and is now building homes to an increasing degree in suburban and rural areas. Department of Commerce[5] estimates that in 1950 34.5 million passenger automobiles will consume an average of 17.5 barrels per car.

The extent to which motor gasoline and, therefore, motor lubes will be consumed during the next five years will depend to a great extent on the economic status of the American public and the scale of living they are able to carry out. It should be noted here that the older cars on the road unquestionably consume more lube oils per gallon of gasoline than newer cars. However, it is also true that the American public is paying more for its automobiles today and is more careful to protect the engine and considers the operating costs of lubricating oil a small item compared with the life and protection of its investment.

Department of Commerce[5] estimates 5.7 million trucks registered at the end of 1946 will increase to 7.2 million trucks using gasoline in 1950, and 107,000 buses registered in 1944 to increase to 135,000 in 1950. With regard to farm trucks, the war stimulated the use of mechanized equipment on farms and the trend has been for greater use of gasoline for these units. The number of farm tractors in use in the U. S. increased from 1,009,000 in 1943 to 2 million in 1945 and 2,800,000 in 1946.

This trend is predicted to continue by farm industry authorities, with great improvements in power units including greater operating comfort and ease of handling tractors including independent running power take-off. According to manufacturers, this is a device by which power is supplied by shaft to a farm machine where the farm tractor operator will have full power at the take-off independent of the ground speed of the tractor. Department of Commerce[5] estimates that in 1950 3.2 million tractors will consume an average of 800 gallons of fuel per tractor, of which 80% would be gasoline. Lube consumption for farm tractors is comparable to automobiles.

Diesel Use Increasing

The increasing use of Diesels for railroads is indicated by the consumption figures issued by Interstate Commerce Commission of 167,000 barrels in 1936, 7 million barrels in 1944, 10 million in 1945 and 12.5 million in 1946. The first Diesel power main line passenger train was put in service in 1934 and in 1945 there were 3,401 Diesel motors in service. There is a definite trend towards a conversion of the major portion of steam capacity to Diesels and the annual Diesel production capacity for railroads will have reached 1,000 units during 1948. The demand for Diesel fuel in 1950 as estimated by Department of Commerce[5] is 25.5 million barrels, or more than double the 1946 consumption.

Since over the past 10 years the consumption of lube oils for industrial purposes amounted to 32% of the U. S. production of lubes, we are interested in looking into industrial activity. The Federal Reserve Board production index, which uses 100 as the base average for the years 1935 to 1939, has been used by McIntosh[2] for prediction of lube oil demands in the industrial field. It represents production in factories and mines. These indices have averaged between 125 for 1940 and 239 for 1943. In the year 1946 this index was 171 average for the year but dropped to 159 in May due to strikes and reached 184 in the fall. The index for 1947 was 187 and for 1948 it is expected to average 189. It is predicted that this index will be between 180 and 190 for the next four years barring any major labor upsets. Based on these indices industrial lube requirements should remain between 45,000 and 50,000 b/d during the next five years and reflect increased lube demands in other fields as a result of the lube consuming units manufactured.

1951 Demand Up 20%

Taking an overall look at the world picture, the future demands for crude oil and all petroleum products requirements are expected to increase from approximately 8.3 million b/d of crude oil in 1947 to 10 million or more b/d in 1951.[6] Where the demand per capita in the U. S. was 13.9 barrels in 1947, the demands for the rest of the world excluding U.S.S.R. were only 1.4 barrels. There will, therefore, be considerable catching up to be done by the rest of the world in consumption of petroleum products as increasing demands of industry, mechanization of farms, modernization of railroads and increased automobile usage really gets under way in other countries outside the U. S. With regard to lube oils outside the U. S., the production for 1938 of about 60,000 b/d dropped to practically nothing at the conclusion of the war. Exports from this country were short of requirements over the past few years but reached 40,000 b/d in 1947. Figures given previously in this paper show the estimated production up to 1951.

It is evident from these figures that exports will continue at a high rate from this country and that a great deal depends on how fast Europe, South America and the Far East develop their industries, use of automobiles, Diesels for railroads and farm tractors for farms as to how great these demands will be. The potential is definitely very great and pessimistic predictions may be found to be considerably in error.

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High-capacity mechanical coal loaders such as this are one reason the coal industry believes it can cut production costs —and thereby improve the economies of synthetic liquid fuels from coal

Photo courtesy Pittsburgh Consolidation Coal Co.

COAL-to-OIL Plants Loom Closer

Recent Announcement of Gulf-Koppers Agreement For Joint Research on Coal Gasification Points up Increased Tempo of Activity, Progress in this Field

IF YOU have any doubts as to where the future of synthetic liquid fuels lies—take a trip to Pittsburgh.

There oil and coal have joined hands in two of the greatest private research enterprises ever undertaken to search out new and improved means of obtaining liquid fuel from solid coal.

Latest development in the Pittsburgh area was the announcement early in June that Gulf Oil Corp. and Koppers Co. had signed an agreement for cooperative research and development of processes for converting coal to gas and liquid fuels.

Previously, in March, 1947, Standard Oil Co. (N. J.) and Pittsburgh Consolidation Coal Co. had announced a similar joint project. Work on their undertaking has progressed to the point that a $500,000 pilot plant for gasifying coal is expected to be in operation next month.

The Gulf-Koppers agreement, which had been in the making for two years, caused little surprise in the industry. It was the natural result of two neighboring companies with complementing interests. As a joint statement from the two firms puts it:

"Gulf has long been a specialist in liquid fuels technology; Koppers has long been a specialist in solid fuels technology. We believe it only reasonable to anticipate that our knowledge in these two fields can be combined to develop more promising industrial processes for converting solid fuels into gases and synthetic liquid fuels."

Gulf and Koppers under their research agreement will be primarily concerned with gasifying coal to produce a synthesis gas, and then processing that gas into liquid fuels and other products. At present the companies contemplate only the exchange of information, with each continuing to carry on its own research. Eventually, the cooperative program may lead to the establishment of pilot plant facilities to further the joint development of laboratory research.

If the research work progresses satisfactorily in the direction expected, Gulf and Koppers would undoubtedly consider building a commercial plant, although officials of the companies would not discuss any details of such a possibility. In all probability, any such commercial plant would be financed and operated by Gulf, with Koppers undertaking the engineering and construction phases.

Gulf has been active in the study of synthetic liquid fuels for about ten years, and during that time has done a good deal of fundamental research on the subject. All its research activities are carried on by its subsidiary, Gulf Research and Development Co., with extensive laboratories at Harmarville, just outside Pittsburgh. At present Gulf has about 20-25 members of its research staff working on the synthesis of liquid fuels, and is devoting about 10% of its research budget to this activity.

Head of Gulf's research activities in synthetics is Eugene Ayres, a middle-aged man who has been with Gulf for nearly two decades and who in true research fashion is always looking into the distant future—"perhaps too distant, in some opinions," he'll confess with a sly grin.

It was Ayres who two years ago began selling the idea of the Gulf-Koppers tieup. It was also Ayres who last spring declared that the Wolverton bill (providing for government financial support for the building of commercial synthetic fuels plants) was "premature." Commercial plants designed from data which will be accumulated during the next few years, he stated at that time, might actually get into successful operation sooner than plants designed immediately from present inadequate data.

He is still convinced that we don't yet have the right answer to the

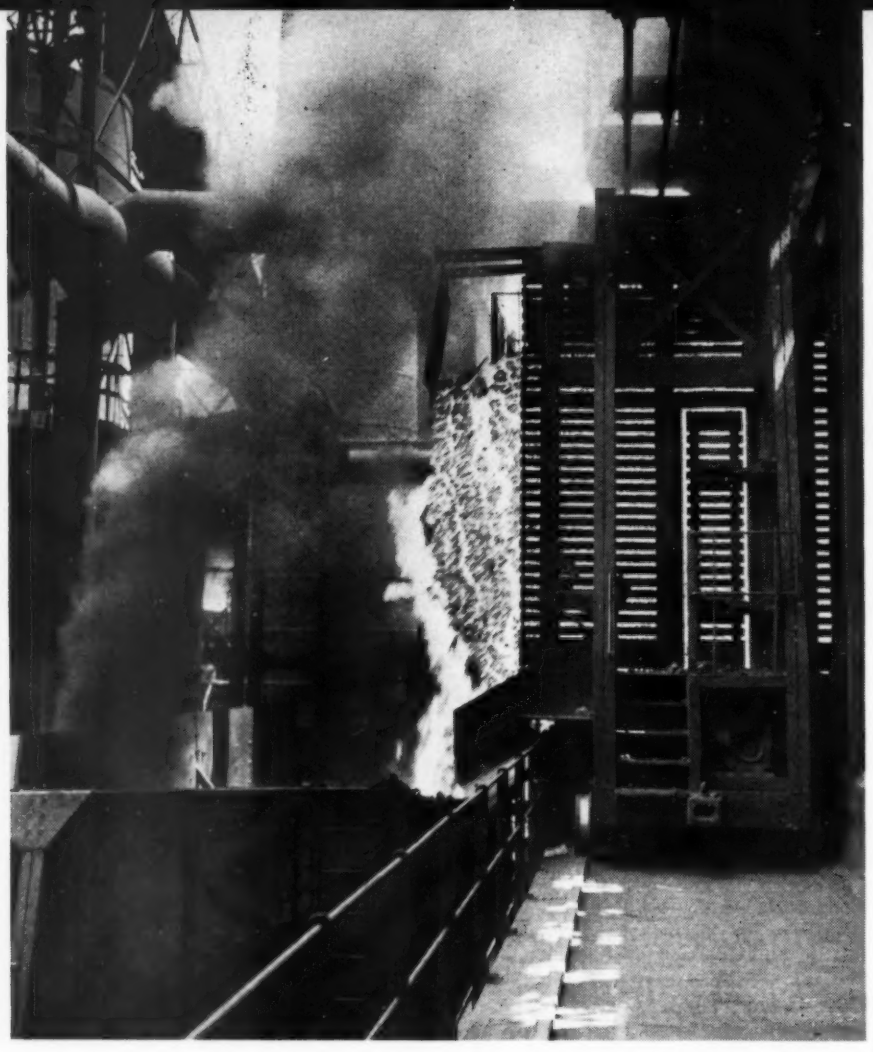


Photo courtesy Koppers Co.

Koppers Co., which recently announced an agreement with Gulf for joint research on synthetic fuels from coal, is the foremost designer and builder of byproduct coke oven plants such as this one, an activity which has given it much practical experience in the handling of gases produced from coal

question of the best process for manufacturing synthetic liquid fuels. Although the commercial plants now being built are based on the best information available at this time, in his opinion they'll become obsolete very rapidly.

Koppers—40 Years Old

The Koppers Co., the other half of the partnership, is almost an unknown entity to most of the petroleum industry. The company is primarily of repute for its operations in designing, engineering and constructing byproduct coke oven plants.

Its history dates back to 1907, when Dr. Heinrich Koppers, a German scientist who had invented a new coke oven, came to this country at the invitation of a group of U. S. Steel engineers and established a branch of his German engineering firm at Joliet, Ill. By 1912 headquarters of the H. Koppers Co. has been established in Chicago, and the company was building byproduct coke ovens for a number of steel companies.

The tremendous possibilities of the Koppers' process were foreseen by a group of Pittsburghers headed by H. B. Rust, and in 1914 they purchased a major interest in the Koppers Co. and moved its 85 employees to Pittsburgh. Although the company still bears his name, Dr. Koppers (now dead) returned to his native Germany, and the firm has been owned entirely by American stockholders for nearly three decades.

Today Koppers is one of the foremost consultants and builders in the coke oven field, and is also actively engaged in tar refining, wood preserving, and the manufacture of gas, coke, chemicals and machine shop products.

Its interest in synthetic liquid fuels stems from its coke oven activities, which have given it a good deal of practical experience in producing and handling gas from coal.

Just recently the company was awarded the contract for engineering and constructing the $4,500,000 Fischer-Tropsch demonstration plant which the Bureau of Mines is erecting at Louisiana, Mo. This plant, designed to have a capacity of 80 b/d of oil and gasoline, includes coal gasification, gas purification, hydrocarbon synthesis, and product refining.

Although several means of coal gasification are being studied by the Bureau, the new demonstration plant will employ a process developed by Koppers and sometimes referred to as the "Koppers Dust Process." It involves feeding finely pulverized coal, together with oxygen, carbon dioxide and steam, into a reactor, operating at 2500° F. and 10 psig.

Koppers is discreetly silent when it comes to talking about its new "Dust" process, but some authorities believe it may have even more promising possibilities in the synthetic field than Jersey Standard's Fluid process. The Bureau's decision to employ Koppers' process is certainly indicative of its state of development.

Another activity of Koppers which ties in with synthetics is the large scale manufacture of oxygen, needed for the coal gasification step. In cooperation with two other companies, Bethlehem Steel and Air Reduction, Koppers is now completing at Johnstown, Pa., an oxygen plant which will be the largest individual unit of its kind yet built. Bethlehem will use the oxygen in its blast furnace operations.

The new oxygen plant will operate on the basic Linde-Frankl cycle of compression and expansion, with subsequent fractionation. It is said to involve 2-stage compression of the air. Output will be about 150 tons daily.

Head of Koppers' research activities is Fred Denig, vice president in charge of research. His right-hand assistant who has been assigned responsibility for Koppers' activities in the field of synthetic fuels is A. R. Powell, one of the members of the Technical Oil Mission, which in 1945 followed the advancing Allied armies into Germany, investigating every phase of that country's synthetic operations.

Koppers' research department, with administrative headquarters in Pittsburgh, operates a number of research laboratories and pilot plant facilities in connection with the activities of the various divisions.

Most of the work on coal gasification is carried on in the companies' laboratories at Kearny, N. J., where it also owns and operates a large coke oven plant, the gas from which is sold to public utilities in the vicinity.

P-C Building Pilot Plant

As indicated earlier, the synthetics research undertaking of Pittsburgh Consolidation Coal Co. and Standard Oil Co. (N. J.) has reached the stage of development where the former company expects to have its coal gasification pilot plant in operation next month (September). This joint research project was first announced in March of 1947.

The pilot plant is being built by P-C at Library, Pa., a little mining town about 15 miles south of Pittsburgh, where the company has estab-

lished its research center. Ground was broken in March of this year, and so far construction has progressed on schedule.

At the time this joint project was first announced, it was expected that the pilot plant would cost about $300,000. That was last year, and today the figure is probably nearer $500,000.

The plant will use about 100-150 lbs. of coal an hour, from which it is expected to produce a 300 BTU synthesis gas, operating the plant at around 70% thermal efficiency.

P-C is at present the largest commercial operator in the coal industry. The company was formed just about three years ago with the merger of Consolidation Coal Co. and Pittsburgh Coal Co., and today produces some 5% of all the coal mined in the U. S.

Although research activities among coal companies are a rarity, P-C isn't without some experience in this field. One of the two original firms, Pittsburgh Coal Co., since the early 1930's has carried out research and pilot plant activities on a process for the continuous low-temperature carbonization of coal, aimed at producing a premium smokeless fuel and a special grade of tar.

Research Program Started in 1946

The present intensive research activities of P-C, the biggest thing of its kind any coal operator has ever undertaken, first began to be formalized in 1946. Early in 1947 a Research and Development Division was established, with Joseph Pursglove, Jr., as vice president in charge.

When the agreement with Jersey Standard was announced, the research staff hardly deserved that name, it was so small. But today it has been increased to over 50, and by the end of the year is expected to be up to 125.

P-C hasn't gone into the synthesis field, it is frank to admit, with any idea of finding a solution to the possible present shortage of liquid fuels. It is primarily a coal company, and its first interest is in disposing of as much coal as it profitably can. If gasoline and fuel oil can be made from coal, then P-C is interested—not for the sake of the gasoline and oil, but for the coal.

Some idea of what a coal-to-oil plant would mean to P-C in terms of increased coal consumption can be realized from a few figures H. S. Turner, director of P-C's research and development division, passed on to us:

"A plant which would produce around 13,000 b/d of oil would require as much as 2½ million tons of coal a year. . . . Today less than 150 coal mining companies, of a total of about 7000, individually produce more than 2,000,000 tons annually, based on the 1946 record."

The company believes that it is in a geographical location where a coal-to-oil plant has the best chance for economic success. Pittsburgh is in the tri-state area of western Pennsylvania, eastern Ohio, and northern West Virginia, with its concentrated population and industrial activity. Cheap river transportation is available. And, most important of all, P-C has large coal reserves in the area.

P-C's thinking on how to make oil from coal isn't confined to synthesis. There are at least two other routes which the company believes may be followed.

The first of these is based on a general policy of using coal instead of oil in power plants and large industrial and institutional installations. Pursglove sees this method as the easiest way to get a million b/d of oil, but admits that it would "take a lot of doing." The steel required for switching burners from oil to coal would be picayune, he believes, compared to the steel needed for an equivalent production of synthetic fuels from coal.

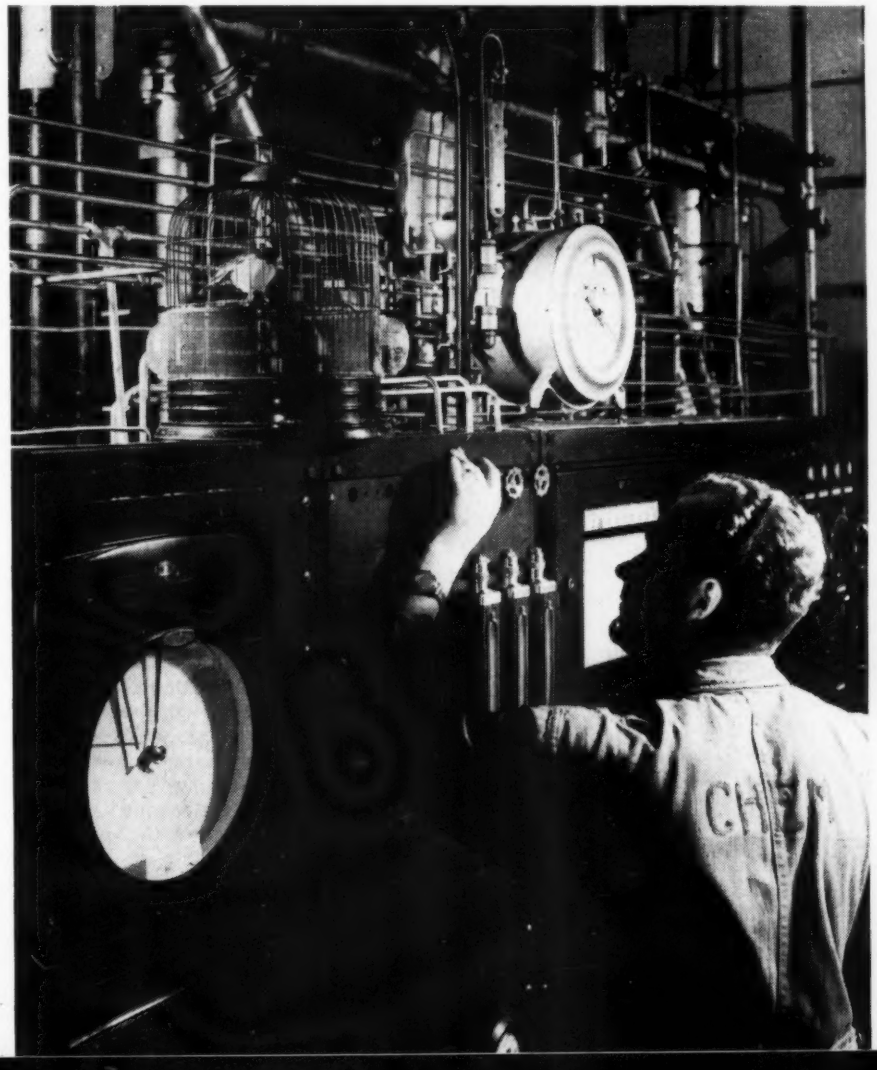
Another route P-C is working on is low-temperature carbonization and the company has high hopes of developing a continuous commercial process which will yield about ¾ bbl. of tar per ton of coal carbonized, together with a high-BTU gas. The tar could be used by steel manufacturers in place of the 20-30 gal. of fuel oil now burned per ton of finished steel.

One point seems readily apparent when talking with officials of both Koppers and P-C—and that is that neither company seems to have any intention of going into the business of making and selling synthetic liquid fuels in competition with the petroleum industry.

Koppers' main interest is in the plant engineering and construction phase—and P-C is primarily concerned with increasing the market for its coal.

Gulf's research on synthetic fuels has been going on for over ten years. To protect its research workers from the deadly effects of carbon monoxide, all of its pilot plants where Fischer-Tropsch type operations are carried on are equipped with canaries. While a man may feel only a slight headache after 20 minutes in an atmosphere of 0.25% CO, canaries show alarm in one minute and fall from their perch in three minutes

Photo courtesy Gulf Research & Development Co.



REPORT FROM BRITAIN

Fine Supply Job by Petroleum Boa
Has Saved Oil Industry there fro

Through the war period and until June 30th last the supplying of petroleum products throughout the United Kingdom was done entirely through cooperative management of the oil companies in England, through a group of oil men known as the British Petroleum Board. So efficiently did the privately owned oil companies function under this arrangement that there has been no reason or even excuse for the Labor Government to consider nationalizing the petroleum industry, as it has several other industries.

This story and other observations on social and political conditions in England come from on-the-spot reporting by Warren C. Platt, publisher of *Petroleum Processing,* who is on his first return trip to England and the Continent since 1944-45, when he served as a special war correspondent studying and writing on how petroleum served in the war. Other articles will come from Mr. Platt while he is abroad which should help American oil men to get a clearer conception of the forces and ideas there that may be pressing in on the American oil industry.

LONDON — The British oil industry has just passed what undoubtedly is the most critical point in its history, that point at which it would be only natural to expect oil to be caught in the sweep of the British Labour party now in power to take over many important industries.

That the British oil industry successfully passed this point augurs favorably for the political future of the industry here just as it does for the oil industry in the U. S. Had the British oil industry been socialized it would have greatly encouraged the American proponents of government control, and such encouragement could be difficult for the American oil industry to contend with, especially in case of any further shortening of supplies.

Good Management Job

The reason for the British oil industry escaping socialization by government was largely due to the great job the British oil industry did in co-operative management of the industry and its supplies to public and the military during the past nine years of war and peace. That job was done by a group of oil men known as the British Petroleum Board backed up by top government officials. Under the sole management of these men, the entire oil industry in the United Kingdom pooled all its equipment, all its manpower, it business and its brands, for the Petroleum Board to do with in all respects as it saw necessary. It was a 100% monopoly.

Board Dissolved June 30th

This June 30th, the Board came to a peaceful and respected end, and equipment, manpower, and customers were handed back to the original companies. No one anticipates any anti-trust suits being thrown at them, even though in many ways the Labour Party government seems to be as politically minded as our reformers back in the States, but they don't seem to be "anti-trust" minded over here.

The size of the job this war pool did is indicated by the fact that it handled from ship to final consumption here and to the armies on the continent and in North Africa, almost 1,000,000,000 bbls. of oil valued at more than $2,000,000,000. To manage this volume the Board had to build and operate more than 1000 miles of buried pipe lines in the U. K. with an immense amount of storage both above and below ground, and at the same time organize into one operating unit from 20,000 to 22,000 employes, transferring them frequently about the country. The number is now up to 24,000 with the return of peacetime gallonage.

These people are all workers, at terminals, pumping stations, and bulk plants, and operators of trucks and barges. All this operation was accomplished with a minimum of office help. Therein this organization represented the very opposite of what we usually call bureaucracy. And all this the Petroleum Board did under the most severe war conditions, with continual bombardment of plants and facilities and employes by air raids and flying bombs, which many days arrived every few minutes on some large areas like London.

And Now—Competition

As of June 30 these employes return to their original companies as of the start of the war. The equipment is likewise now being sorted out for return. After this is done the revived old companies are free to search out their old customers, if they still exist, at all events to have their prewar percentage of business out of what exists now. For a short period, expected to be 3 months but subject to extension, no company is to solicit the customers of another, nor try and take more new business than its share. The degree of competition that was expected to exist here after this sorting out will be modified by the severity of the present rationing of all petroleum products and the limitation likewise placed on rehabilitation, new construction, new equipment and the use of manpower, because of the world shortage in petroleum and steel and Britain's shortage of dollar exchange.

There could have hardly been any

Great Britain ocialization

By WARREN C. PLATT
Publisher
Petroleum Processing

other type of set-up that would have made it easier for a government to take over an industry than obtained in this British oil industry. Here it was compact, well trained for 9 years, stripped to the minimum of facilities and manpower and all a complete and highly economic operating unit. Also all the oil distribution industry was tied together in one comprehensive system of records and accounting and bank accounts, things that the average government bureau messes up pretty badly when it ventures into business activities.

Public Also "Adjusted"

Further suggesting the auspiciousness of the moment for government taking over the business was the fact that for these 9 years the public had become accustomed to buying only one brand grade of motor fuel, "Pool", and kerosine and Diesel oil. The industrial world had become well acquainted with the fact that, while lubricating oil distribution was left in the original lube companies, nevertheless the customers generally knew that all oils were cleared through the purchasing of the Petroleum Board.

Never, one may well believe, was any industry in such an inviting condition and position for government seizure. We of the U. S. may look in comparison at our own highly efficient Petroleum Administration for War, so well run by some of the ablest men in the industry. However, the PAW was not the possessor of the oil industry and all its facilities, PAW was not the employer of the industry's workers and PAW was not the operating administrator of all its ramifications to the public and the collector of its sales income.

Strict Organization Necessary

On the other hand, here in England, the industry had to have this compact self operating organization, as highly disciplined and under as absolute orders as was the Army, Navy, or Air Corps, or England probably could not have survived even the beginnings of the war. An aggressive and powerful enemy only 20 miles across the Channel not only easily flew large bombing planes and flying bombs half way up England, but even threw shells from its large guns directly across the narrower parts of the English Channel and wrecked many towns. All this was entirely different from operating an oil business in peace and quiet and complete physical safety.

To sum it all up, this still privately owned and privately but war operated oil industry, was the very epitome of what Socialists and Communists have so long and desperately striven for. The high efficiency of this private-monopolistic oil industry was what the totalitarians have long tried to create when they did get a hold on business enterprises but in which they have always failed; an efficiency that the present government-owned and operated industries of the United Kingdom do not have and, if one may guess, never may achieve; an efficiency beside which Russia's efforts are a joke.

It was an efficiency which left proponents of nationalization without their seeming rather well justified argument in the case of the other industries that they seized, the argument of gross inefficiency.

Other Factors Involved

There were other factors that undoubtedly prompted the British Labour Party to pass up nationalizing oil. The Labour Party had bitten off a pretty large mouthful and was showing every evidence of having difficulty chewing it. Then, petroleum products and their quick and intelligent application to the wheels of industry, the farm, of transportation and the supplying of the daily needs of the people are vital to speed England's recovery. Distributing these petroleum products, giving the necessary engineering knowledge to insure their correct use, enlisting the petroleum industry to help sell, as it has all over the world, the efficient producing tools for the public, is so complex and so much a personal thing on the part of the individual in oil, that the "nationalizors" decided to let well enough alone.

There also was presented the story that the industry's great future service to England's recovery called for the investment of hundreds of millions of pounds and dollars for immense new refineries in England, heretofore not much of a refinery country; for research; for new distribution facilities; for tankers and large production of crude oil overseas. It was generally known that a very large part of this new investment, and of its engineering and equipment, would have to come from the U. S. in much needed dollars. Harldly could private American citizens be expected to build up government monopolies against themselves.

Oil Was Slated for Nationalization

While there was no public discussion of the idea of taking over oil and debate in Parliament chiefly concerned minor phases, the initially avowed purpose of the Labour Party when it came to power included oil in its published program. So the escape of the British oil industry is far more to its credit, to the credit of the job it did and the credit of its "public relations," than the escape of American oil so far from the grasping of the present and past administration at Washington.

But however well off American oil men may now think themselves, and whatever comfort they may feel in the probability of the election of private-enterprise-believing Republicans, the American oil man should keep in mind that England has always been a conservative country and yet "it did happen here". At the moment more seeds are being sown over here that will sprout action against private ownership than will protect it, let alone help develop it.

Ideas on Situation There

For whatever they are worth to you, the reader, here are some ideas on the English situation the writer has obtained from newspapers and many private conversations with per-

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sons on many economic levels and with non oil men.

Many believe that the drive for socialization was put over to an important extent by the men returning from war, whose thinking had been of things other than government and business and many of whom had been too young for business education. Some held what has undoubtedly been an ever growing desire of the last two centuries to reduce the gap between the wealthy who inherit power, money, land and social position without having to work for them and those who work.

Harsh Measures Needed

Now that the country is under stringent rationing and regulation, many of these same men who voted for the Labour Party are even bitterly critical and rebellious against the restrictions. However, conservative observers among business men, who are critical of the good sense of some of the socializing and how it has been carried out admit that any effective measures, no matter by whom, needed to bring about England's recovery must necessarily be harsh and appear unfair to many of the public.

While a reasonable amount of vegetables, fish and chicken and a meaty dry sausage can be had at government-set prices at the best hotels and restaurants, it gets rather monotonous, especially when one hears all the time about how "bad" the food situation is even in the best hotels. One is lucky to get a thin slice of beef once a week, maybe two slices of mutton a week, with an egg on two mornings accompanied by a thin and small slice of bacon. Even for this one must speak to his floor waiter the day before or very early in the morning, or earlycomers will get the limited number of eggs or the half dozen skimpy steaks — at the most — assigned to a floor.

Payment, not Charity

All this is more than the general public gets or can afford to pay for. And what they get is only after standing in line—queueing—for an hour or three hours at a stretch perhaps in the rain and maybe with a crying baby under one's arm. "Bundles to Britain", or to any other of the hard pushed countries over here are God-sends, so if you know any one send the limit—22 lbs. a month I think—or chip into one of these reliable basket shipping organizations. This is not charity but part payment to a people who stood the brunt of the worst and longest of the war and who are now paying a far higher price than we in the U. S. have any idea of.

You have to suffer the bombing to truly appreciate its horror and damage. As a returning war correspondent with 9 months in England and Europe I had told my wife of the bombings and thought I had done a rather accurate job. But after she made a couple of trips through the wreckage of the vast bombed sections of London, she said she really had no conception from my recounting of the extent nor the horror of it.

Her depression was intensified when she heard from women of their own bombing experiences, of being knocked senseless, of roofs blow off, homes destroyed, of being only a short block down the street from a home where food had been taken to a sick woman and into which one had just sent the milk man—and then to be knocked flat as the house, old woman and milkman went up in the air, in such pieces that the air raid wardens never found enough of them to put in a box.

This happened in many towns and in France and Italy and of course in Germany and beyond. All the war correspondents would have liked to have written much of such horror illustrated by many human incidents, just as I would have four years ago, but such stories were strictly forbidden by the military so all you read would be a terse report that "an incident had occurred" from bombing.

Vast Areas Still Show Scars

For example, no publicity was permitted about the bomb that hit a downtown church during Sunday morning services and killed some 800, or that knocked out a section of a department store or of all the other bombings that leveled hundreds of acres of London. One still bleak and unrebuilt area in the Old City that had teemed with heavy and important business life is larger than all "The Loop" in Chicago. You cannot go but a few blocks in London and some other cities without encountering ghastly scars, still raw and gruesome. Much has been cleared away and some places rebuilt, but it will be many years before any considerable number of these scars are closed up.

It is experience such as this, daily refreshed by the scars all about, though people don't talk about them nor seem to look at them, that has much to do with the political temper of the English people. If the British soldiers could have returned to an undamaged country, with buildings and homes intact, with food and clothing and other necessities and comforts of living such as we have in America, it is to be questioned if the Labour Party could have gone anywhere near as far in applying socialism as it has. But today people don't feel that their sense of hunger is ever satisfied, in fact many believe the official diet greatly undernourishes them. Many elders are giving of their food rations to the children and they worry that this generation may not be strong enough to stand up against the difficulties of tomorrow.

"New Look" Is Rare

Many people are also constantly reminded of their difficulties by a highly developed consciousness—unfortunately, only too well justified—of being shabbily dressed. Only a handful of well-to-do women enjoy via the black market the "New Look." The few ration coupons do not permit them to buy, even when they have the money, enough new clothes in a year to give the impression that they are well dressed. The wife of a well-to-do American oil man said that whenever it was that they would be going home, if conditions were not any better in England, she would take only enough clothes back to serve her the five days on the ship to reach New York—the rest she would distribute to friends and acquaintances to none of whom, in ordinary times, would she casually dream of offering even a pair of stockings.

Some here say they will never flee from England and her troubles but a surprising number, including some from good society levels, are thinking and hoping they can move to the U. S. or to Canada. One woman with much money but all frozen hard in England, hopes that in some way she can move to the U. S. with her son, who is just out of college, where she believes he and his descendants will have greater opportunity. Another mother the other day quietly slipped into the family's small "Go to America Fund" unbeknown to her husband, the difference between the price given her by her husband for a ready-made coat and the cost of the cloth from which she actually and in secret made a wearable coat.

May Never Uproot Socialism

There are many of these in all walks of life. They don't like today's politics and while they hope to defeat the Labour Party in 1950 they fear they will never be able to uproot Socialism. They are tired of the battle and, in the back of their minds, while they think Americans are unduly alarmed over possible trouble with Russia, they are fearful of the future, realizing only too

To simplify his rationing problem, this dealer refuses to serve private passenger cars at his station. He is located, however, at an important intersection of one of the main roads going west from London so he gets much truck business. The word "Pool" on the sign on the roof was the designation given to all motor fuel by the British Petroleum Board. With the retirement of the board at the end of June, this sign came down

well they would be probably the first to be attacked and this time with raids and flying bombs that might almost wipe the island off the map.

I don't want to emphasize unduly this sense of frustration, of being tired of hardship, of seeming defeatism or to give the impression that Britain could not nor would not rise with great courage and might to defend herself in another war. Centuries show that her courage and resourcefulness are not to be discounted. However the reader would do well to keep all this personal deprivation of body and spirit in mind as he reads of the country's development of Socialism and other such reforms.

There is little doubt that a big juicy "joint of beef" once a week and another suit of clothes once a year which a Britisher would be only too glad to work hard for, would do much to strengthen the position of private enterprise, that is private enterprise which is intelligently and couragiously dedicating a fair share of profits to keeping up with the future as well as paying decent wages. But perhaps not even a "joint" once a day and a dozen new suits of clothes a year will change political thinking and the course of economics enough to stop the steady decline and disappearance of the power and wealth inherited by those who do not labor for it.

Big Estates Broken Up

Taxes have broken up big estates far more rapidly than in the U. S. They are for sale everywhere, and failing to find purchasers they are being given to "trusts" held in the national interest. These old estates are also being broken up by the prevailing greater employment at better wages so that the large staffs of "help" at low wages needed to operate an estate cannot be collected.

A fair and dramatic, and to us outsiders, laughable illustration of this passing of the old system was the sight of a gentleman rigourously dressed in high gray "topper", long gray cutaway, Ascot tie and stiff collar, busily pedaling down Park Lane, one of London's most fashionable thoroughfares, evidently on his way to join a party for the ultra-fashionable Ascot races, than which there is no greater nor dressier event in all England. The day once was when this gentleman and his brethren would have driven out to this event in nothing less than a coach and eight or, before the war, at least in a long black and shiny Rolls-Royce.

But today with the shortage of cash and gasoline, he jammed his "topper" tighter on his head, humped his back and, with his coat tails leveling out behind, joined the throng of working men and girls on well worn "bikes", but who were going to work. It would be a much better story could we label this "Royalty on a Bike", but he was pumping so fast that even though we dared the impertinence of the question we could only gaze at something from the distant past that got dimmer and dimmer down one of nobility's famous roadways in history and dimmer and dimmer down the avenue of time.

The industries that have been socialized to date by the Labour Party, according to the papers and other reports, do not seem to be doing as well as under private ownership and management, except the great Bank of England which for centuries had been privately owned. The government bought out these stockholders and left the bank to the same management. In addition the government has socialized all the railroads and common carrier truck and other transport and the electrical generating and artificial gas industries. It has for years owned and run the telephone, telegraph and cable systems with a service that is by no means up to that in the U. S. Also the government has long owned and operated all broadcasting.

The coal mines are of recent nationalization and reports published show that less coal is being produced per miner than ever despite installation of much new mechanical equipment. Coal is run by a National Coal Board from which there have been several resignations lately because of disgust of one member with results and fear of much criticism.

Management too Centralized

The chief complaint is that this board has centralized the management within itself too much, like our bureaucracies were doing at Washington when the American revolt came. Which permits the writer to point out that one outstanding reason why the retiring British Petroleum Board did such a good job was that Sir Andrew Agnew, its chairman, and veteran top oil man with world wide experience, and his board, insisted on competent regional managers and, further, that they decide all operating questions, with the Board making only policies and charting the general direction. During the war the writer spent some time out visiting these district managers and he can personally testify to how strictly this highly decentralized operating policy was adhered to.

The criticism of the coal mine management is full and frank and next to it is criticism of the government owned and operated aviation industry, as all of the air lines are losing money heavily. Despite this a cabinet

More to Come

Other articles written by Mr. Platt interpreting conditions as he finds them abroad, particularly with respect to the oil industry, will appear in future issues of PETROLEUM PROCESSING.

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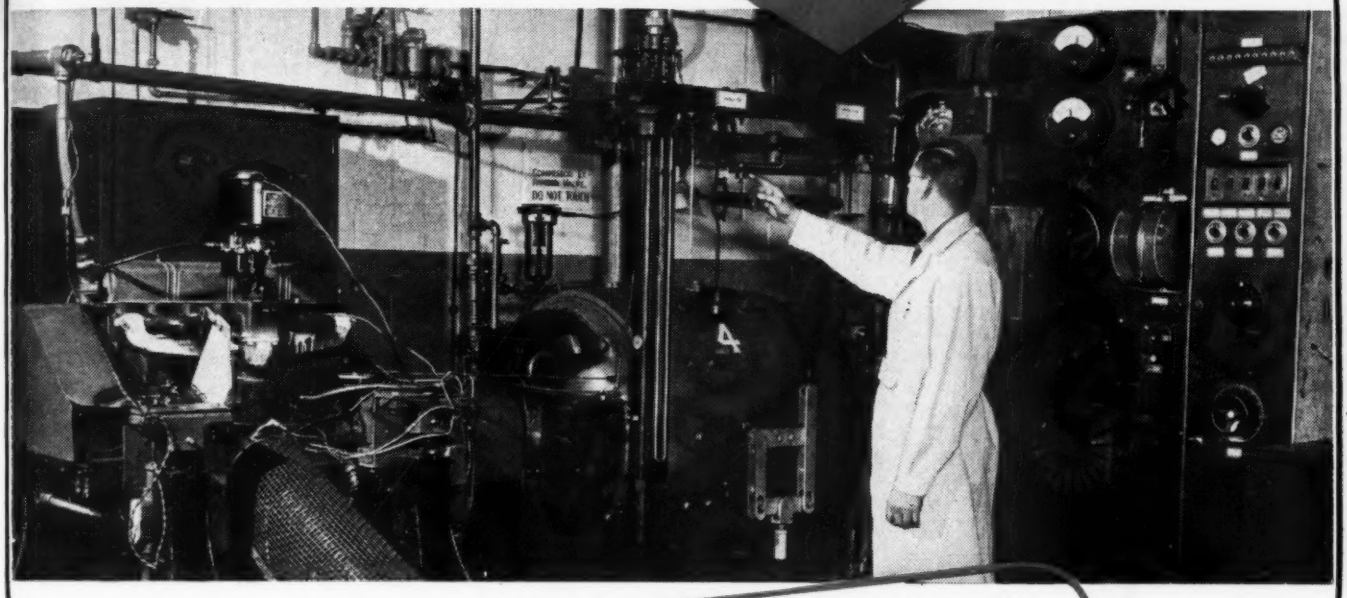

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member flew to a big meeting at San Francisco the other day and got himself roundly condemned in Parliament for patronizing an American air line when his own was in such dire straits.

Despite this unsatisfactory record, the Labour Party is still hard at it to take over the iron and steel industry. Gossip reported in the papers, however, suggests the Labour Party is a bit leery of closing that deal in view of its other troubles but, if it does go through with the steel program right now, it may take over only the blast furnaces and rolling mills. In the meantime the British iron and steel industry under its private ownership and management is breaking all records in volume of production, exceeding its own target most optimistically set months back.

While the government does not own the textile nor furniture manufacturing industries, the government manages them through its severe specifications for only utility furniture and rationing of the products. For some weeks now the papers have been printing reports of how surpluses of both industries are piling up to such an extent that the industries face heavy losses. Some increases in rations of both have been made but the public does not seem to have the money and has not rushed in to buy.

Some Labor Opinion Changing

Some labor leaders are swinging to the conservative side, especially since the big dock strikes here which threaten the country's food supply at an early date. These leaders are urging the men to stay at work and urging government to hold back on more nationalization. A group resigned from some of the dock unions.

Here is some sound advice recently given his 800,000 followers in the strong Amalgamated Engineering Union by their president, a man who heretofore has been regarded as more left than right. Said this union president:

"As workers always on the border line of poverty, with no reserves, we cannot afford the luxury of dallying with nice shades of ideological theory. Neither can we afford risky experiments which affect the basis of our livelihood, however attractive they may appear; we must get our livelihood as best we can in the existing circumstances at any given time. We cannot stop the economic machine, dismantle it and rebuild it."

One can well remark would that some of our eminent (?) labor leaders indicate the same degree of common sense.

But with all this nationalizing of big industries by men who have more political background than business experience, there is the to-be-expected demand for "labour" to take part in the management. A statement recently credited by the London Sunday Times to a railway union official said:

"From top to bottom the administration of industries should be shared with the rank and file having an opportunity to say who should be appointed to managerial and supervisory positions."

That doctrine sounds familiar to an American.

Paper Rationing Worries Many

There is one exercise of government rationing that has many people here much worried, because at first glance it seems logical and yet it is working insidiously to keep the people in ignorance of how the Labour Party is progressing or falling on its face with its socializing schemes. That rationing is of publishers' paper stocks. The paper ration is due only incidentally to the scarcity of paper but it is due chiefly to the Labour Party administration's desire to conserve English money. Hence the amount of paper imported is purely one of arbitrary judgment as against other imports allowed by the very men whose failures in government management of socialized industries would otherwise undoubtedly get a far larger amount of analytical publicity and adverse criticism for their failures if the newspapers and magazines were larger.

Today newspapers and magazines here are down to war size and some days even less. That means a big London paper is printed on four pages only part of the week and on six pages the rest. The London Times seems to rate more paper because it often is 8 or 10 pages but that may be due to its carrying rather fully reports of the daily discussions in Parliament, like an abbreviated edition of our Congressional Record. But that does not explain why the other papers should not have the same amount of paper to print the proceedings, or other information for the public, as they see fit.

Subtle Censorship Charged

Charges have been made by some newspaper groups that the administration may be limiting the supply of paper in order to censor the volume, if not the character, of adverse comment that might well be expected. Recalling how resentful our high authorities at Washington and elsewhere have been of any criticism or exposure of some of their operations, a visitor has difficulty in not believing that the Labour Party is deliberately trying to shut off study of, exposure of and criticism of its own socialistic acts.

Dictators the world over have sought, and too frequently gained, control of the press, meaning all newspapers and periodicals of comment. During the rule of our own New Deal, and even since, American publishers have fought many battles to keep the administration at Washington from bottling up information to which the public is plainly entitled. During the war when there was plenty of reason for a paper shortage, publishers fought to see that the shortage was not made so severe as to come to the same end of absolute government control over at least the volume of information that could be given the public regarding the acts and misdeeds of those in power.

A few years of such extreme paper shortage as now obtains in England will almost insure a lack of enough education, both as to theories being put out and the practices under those theories, to make the public of England as ignorant of the principles and necessary facts on which to judge this socialization as were the people in Germany and as are now the people in Russia.

However the battle is on now, with much heavy hitting, some of it led by the forceful Winston Churchill who, while he may not be universally accepted over here as a great "peace lord", is admittedly a great "war lord", one of the greatest ever. He has declared full war on the Labour Party and is hitting it every few days in the House of Commons and in his public speeches.

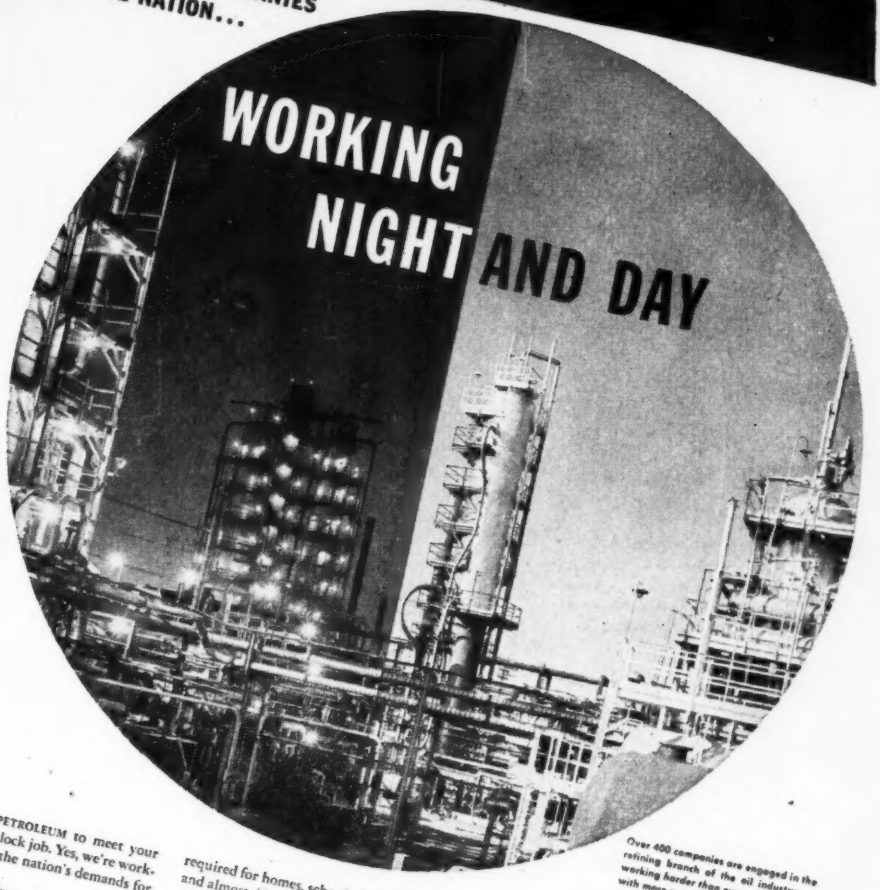
Churchill Still Fighting

One of the most powerful factors for continued freedom of speech, of thought and of action in personal life and in business life in the U. S. is the strength of the American publishing industry. Regardless of any faults, it is the acme of private industry, privately owned and preserved by its own private profits, and they generally are good ones. The "Commies" and reformers may not like American publications but they would have to set up a complete Russian system before they could do anything about it. This privately owned and operated publishing industry will be about the most important factor in blocking those who seek to destroy all government by the people and for the people.

So when one studies the political difficulties of today in England and keeps in mind the advance of socialism and communism on the continent, one should have no hesitancy to give full credit for ability, courage and farsightedness to the men who—at least thus far—have brought the English oil industry through this perilous period so that it is still owned and still operated by its owners, the private citizens of England and, yes, of many other countries including the U. S. of America.

Petroleum's New, Dramatic National Campaign gets the audience ready for you...

HOW 34,000 OIL COMPANIES SERVE THE NATION...



Over 400 companies are engaged in the refining branch of the oil industry... working harder than ever to supply you with more petroleum products.

SUPPLYING ENOUGH PETROLEUM to meet your needs is a round-the-clock job. Yes, we're working night and day to fill the nation's demands for more and more oil.

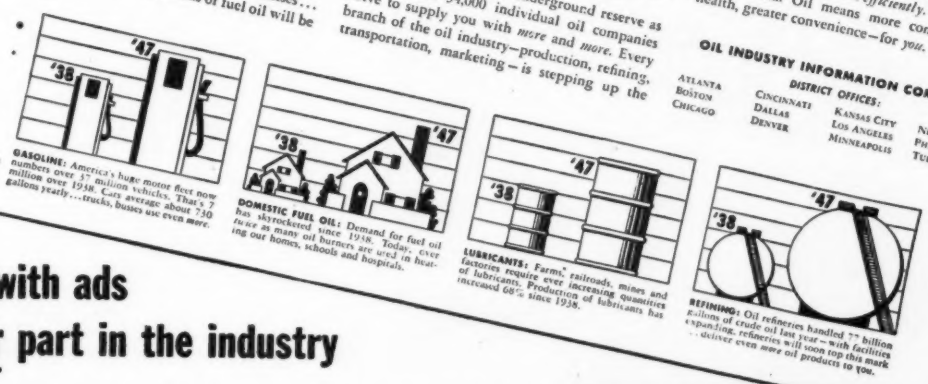
From these efforts has come the greatest supply of oil America has *ever* had—over 200 million gallons *daily*—a flow of petroleum products greater than that maintained during our peak war year.

But we're using more oil all the time! This year, nearly 36 billion gallons of gasoline will be used to power the nation's cars, trucks and busses... this year over 31 billion gallons of fuel oil will be required for homes, schools, hospitals, factories... and almost 1 billion gallons must go to meet huge Army-Navy requirements. Add to this the tremendous quantities of oil needed to keep farm machinery and industrial equipment, planes, trains and ships in motion—and there's the biggest job the oil industry has ever faced.

With a trillion-gallon underground reserve as backlog, over 34,000 individual oil companies strive to supply you with *more* and *more*. Every branch of the oil industry—production, refining, transportation, marketing—is stepping up the pace in 1948... working to supply America's ever-increasing needs.

More petroleum products will be delivered this year. Be sure to use them *efficiently*. Oil is energy for America. Oil means more comfort, better health, greater convenience—for *you*.

OIL INDUSTRY INFORMATION COMMITTEE
DISTRICT OFFICES:
ATLANTA, BOSTON, CHICAGO, CINCINNATI, DALLAS, DENVER, KANSAS CITY, LOS ANGELES, MINNEAPOLIS, NEW YORK, PHILADELPHIA, TULSA



GASOLINE: America's huge motor fleet now numbers over 32 million vehicles. That's 7 million over 1938. Cars average about 750 gallons yearly...trucks, busses use even more.

DOMESTIC FUEL OIL: Demand for fuel oil has skyrocketed since 1938. Today, over twice as many oil burners are used in heating our homes, schools and hospitals.

LUBRICANTS: Farms, railroads, mines and factories require ever increasing quantities of lubricants. Production of lubricants has increased 68% since 1938.

REFINING: Oil refineries handled 7? billion gallons of crude oil last year—with facilities expanding, refineries will soon top this mark ...deliver even *more* oil products to you.

Come in on cue with ads that play up your part in the industry

Throughout 1948, a new and forceful series of advertisements will tell 107 million Americans of the job oil companies like your own are doing to meet today's record demand for oil products. Dramatic ads in Life, Look, Collier's, The Saturday Evening Post, The American Weekly, Pathfinder and This Week will explain to over a million readers how America's oil companies are doing the greatest job in history to keep their customers supplied. And *you* can *directly* benefit from this important national campaign by using free Tie-in ads in your own local advertising.

Get In The Local Spotlight

Your customers want to know what your branch of the industry is doing to supply them with oil products. *Tell* them ... interestingly ... convincingly ... by using Tie-in ads now ready for your local sponsorship. They pay off in customer good-will every time!

Order The New 1948 Tie-in Supplement Now

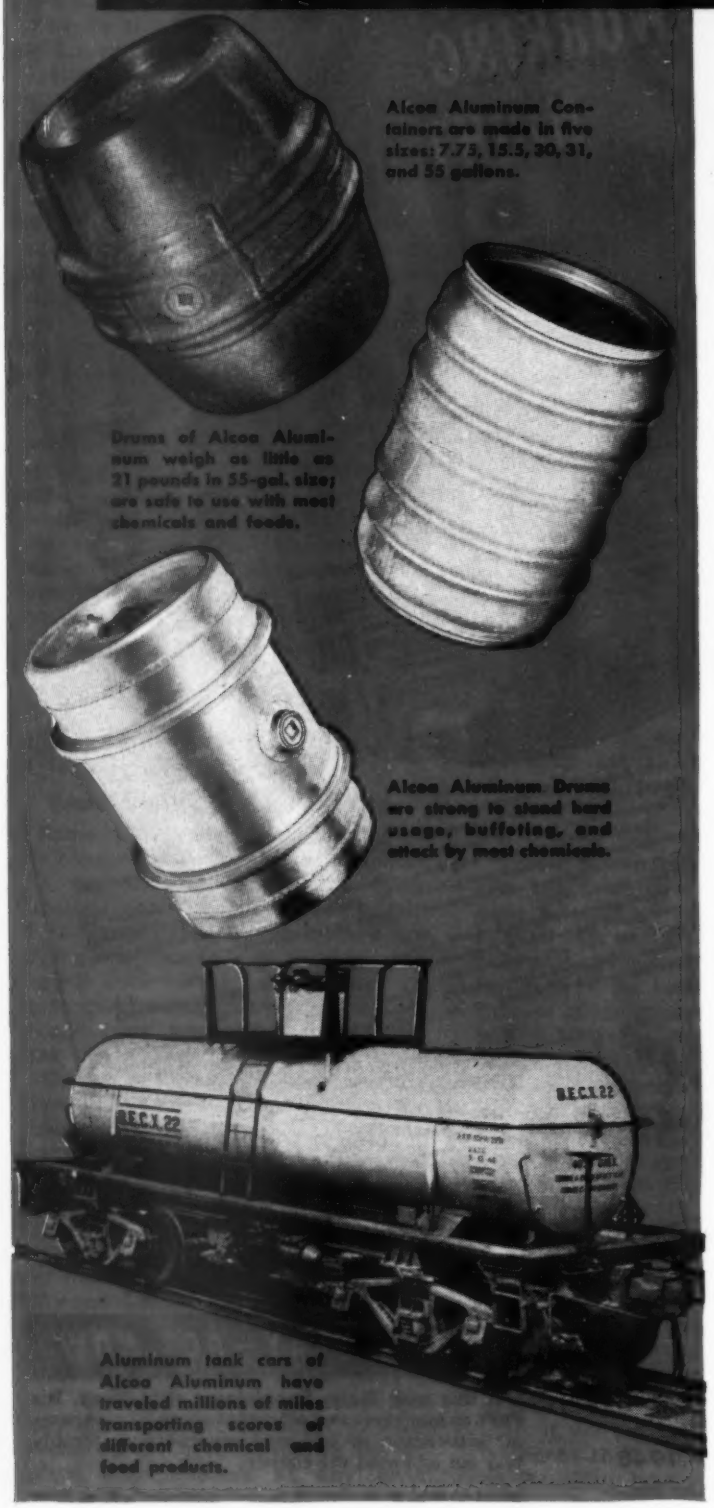
It's filled with samples of new Tie-in ads now available. In addition, it tells all about free radio scripts and recordings you can use ... describes latest promotional aids and special material. Pick out the promotional material *you* want to use in *your* locality—and cash in on the industry's all-out effort to tell the true facts behind America's *greatest* oil supply.

DON'T DELAY—ACT NOW

Get this new Tie-in Supplement right away. It's FREE to managers and officers of every oil company, oil association or affiliated organization. Simply tear out and mail the coupon.

Oil Industry Information Committee, Dept. 12-M
670 Fifth Avenue, New York 19, N. Y.
Please forward at once FREE copy of Tie-in material.
Name .....
Title .....
Company .....
Address .....
City ..... *State* .....

A few gallons... or a few thousand gallons..


Alcoa Aluminum Containers are made in five sizes: 7.75, 15.5, 30, 31, and 55 gallons.
Drums of Alcoa Aluminum weigh as little as 21 pounds in 55-gal. size; are safe to use with most chemicals and foods.
Alcoa Aluminum Drums are strong to stand hard usage, buffeting, and attack by most chemicals.
BECX 22
Aluminum tank cars of Alcoa Aluminum have traveled millions of miles transporting scores of different chemical and food products.

TRANSPORT IT

purer.. safer.. cheaper..

in

ALCOA ALUMINUM

Protect color, purity, and strength of your chemicals and solvents in transit . . . ship in Alcoa Aluminum Drums and Barrels, and tank cars built of Alcoa Aluminum.

No discoloration . . . aluminum cannot cause rust-colored compounds with chemicals. Liquids that must stay water-white travel safely in aluminum containers.

No toxic compounds . . . aluminum is inert to most chemicals and food products, will not cause undesirable side reactions.

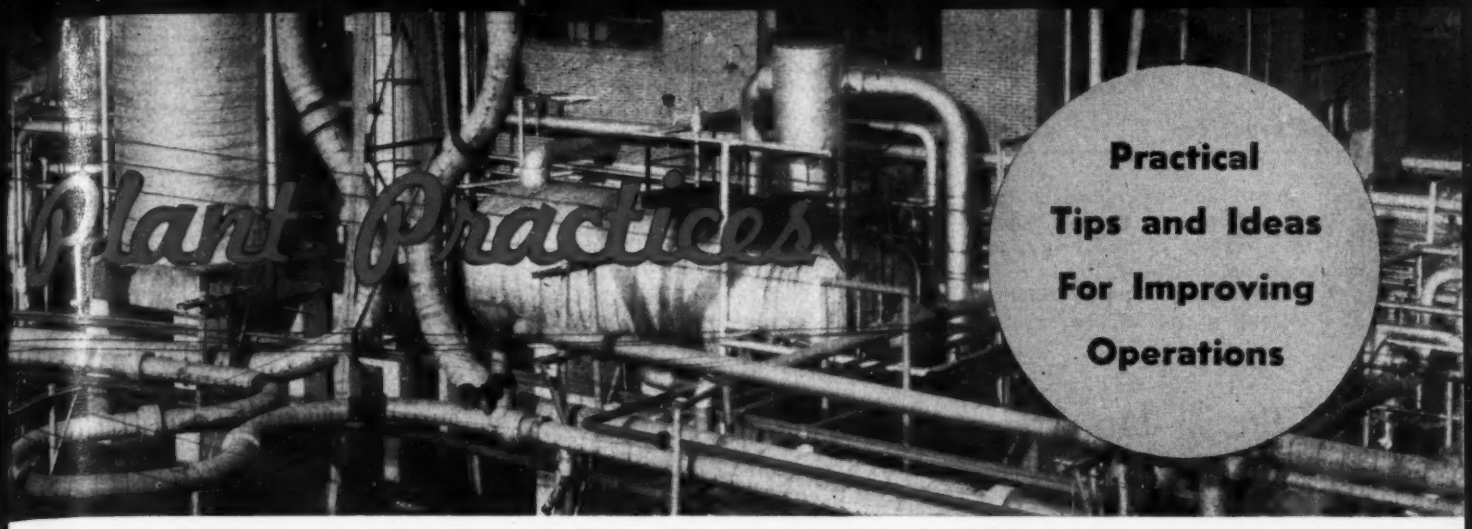
Cheaper to ship . . . you make worthwhile freight-rate savings because of the lighter weight of aluminum barrels and drums. Less than ½ as heavy as comparable steel or wood containers.

Lower maintenance . . . aluminum containers have much longer life, stay bright and rust-free, are strong to withstand hard service.

Write today for prices and information on Alcoa Aluminum Drums and Barrels, and for engineering data on aluminum railroad tank cars. ALUMINUM COMPANY OF AMERICA, 1784 Gulf Bldg., Pittsburgh 19, Penna. Sales offices in 54 leading cities.

ALCOA FIRST IN ALUMINUM

ALCOA ALUMINUM 1888 1948 60 YEARS OF SERVICE



Improve Handling of Maintenance Materials By Installing Rotating Crane in Each Shop

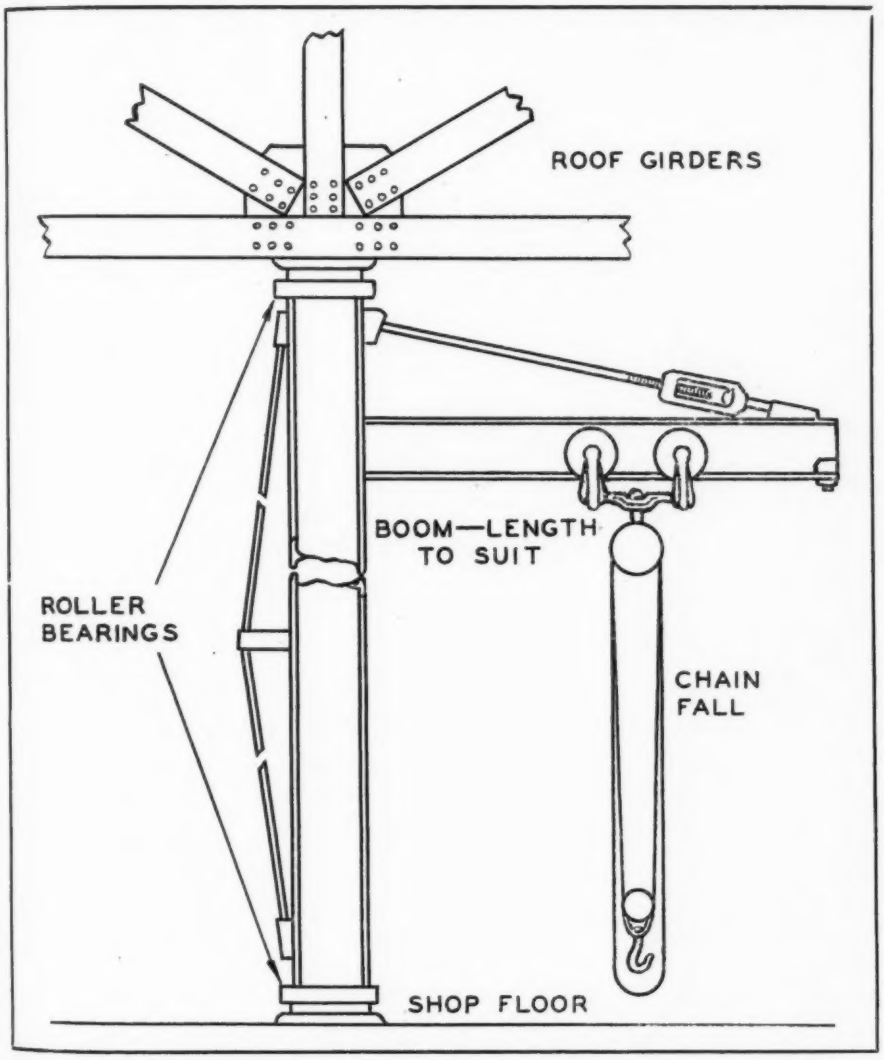


Fig. 1—Socony-Vacuum's rotating jib cranes eases maintenance work

A ROTATING jib crane, permanently installed in the center of each shop—electrical, valve, pipe, machine, etc.—in the maintenance building of the East Chicago refinery of Socony-Vacuum Oil Co. speeds up the handling of heavy or cumbersome equipment, materials, and the like.

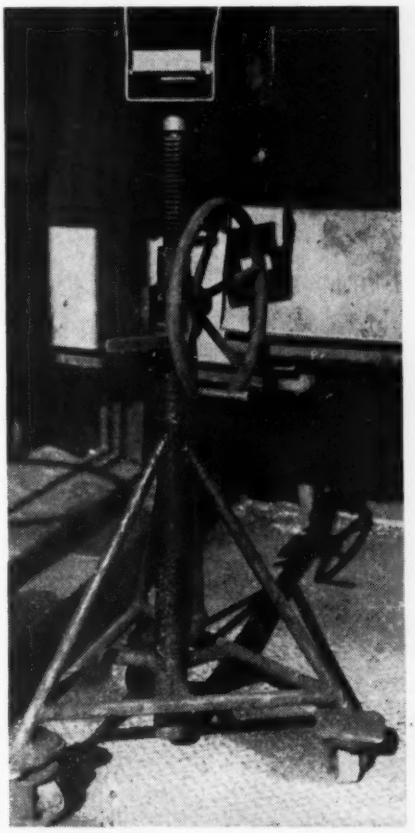
One typical unit is shown in Fig. 1. Free to turn through an entire 360° arc, the crane is constructed of two I-beams forming a vertical post and a boom. It is mounted top and bottom on discarded roller bearings from pumps—discarded because they are no longer capable of high speed service, yet completely satisfactory for slow speeds.

A chainfall hangs from a rolling carriage which travels the length of the boom. The boom is of such length as to almost reach the wall in each shop.

Designed and built by the company's maintenance department, the cranes were installed in an existing building.

Portable Ratchet Jack Useful For Repairs on Furnace Tubes

REMOVAL and re-installation of heavy return bends on the lower ends of heater tubes of de Florez furnaces was a tough, back-straining job at the East Chicago refinery of Sinclair Refining Co. until the maintenance and construction departments devised the simple, portable ratchet



Cradle on top of jack fits snugly around return bends on heater tubes of De Florez furnace

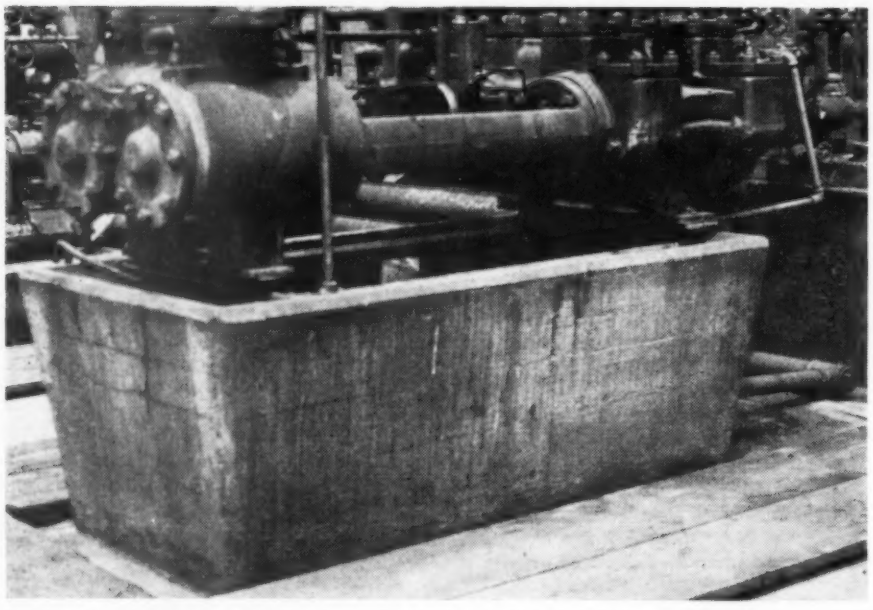
jack shown in the photograph.

The gear box and ratchet mechanism is operated by the large, easy-spinning hand wheel to raise and lower the return bend. The cradle at the upper end is shaped to fit around a return bend and it is rottably mounted so as to be free to turn in a complete 360° arc.

The tripod base of the jack rolls on casters for quick moving around on the platform under the tubes.

No Stoop–No Squat–No Backaches–Repairs Easier with Improved Pump Base

By JOHN C. ALBRIGHT



Union Oil Co. of California's pump foundation provides toe room so repairman can stand upright

PUMP foundations have been built invariably as a solid block with straight sides. This shape, while serving adequately the purpose of supporting the equipment, has caused innumerable back-aches for the mechanics servicing the pump.

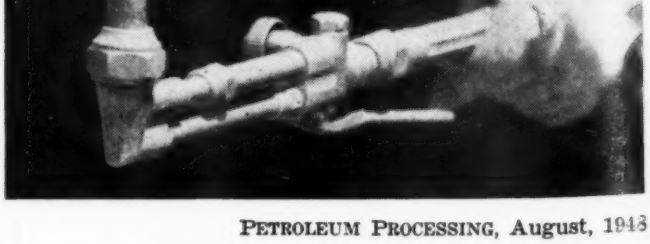
Union Oil Co. of California recently developed a shape for pump foundations which is easy on the repairman. Instead of being a straight-sided concrete block, it might be called an elongated, truncated pyramid with the larger base uppermost. Adequate toe room is provided so that the maintenance man may stand against the unit without bending over to reach the parts requiring attention.

Acetylene Cutting Torch Tip Revamped For Easy Use on Awkward Washing Jobs

CONVENTIONAL straight cutting torch tips are more or less awkward to handle for washing an old bead from a weld in a vessel when repairs are necessary, or when equipment is to be cut down for preservation of plate edges so that rebuilding can be accomplished satisfactorily.

A welder at Union Oil Co.'s Wilmington, Calif., refinery, with years of experience in handling acetylene tools, developed a shape for a cutting tip that gives excellent, fast service. A conventional tip of the size commonly used is heated carefully to the temperature at which it is easily bent. Then, using a mandrel tapered to fit snugly over the tapered portion of the tip, pressure is applied slowly to prevent collapsing the oxygen ducts in the body.

If the tip has been given an inclination of roughly 35° from the vertical, it can be laid on the metal so that the cut is close to horizontal instead of digging into the bead.



Reshaped cutting torch tip provides means for rapid washing of old bead from previous welds

Wire Around Safety Planking Stops "Borrowing" Practices

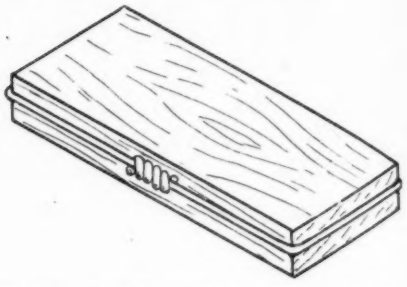


Fig. 2—Sketch showing scaffold plank with protective wire around ends and edge to prevent pilfering or damage

CONSTANT disappearance of their stock of special, safe scaffold planking because someone "borrowed" and sawed them up for odd jobs prompted maintenance men at Sinclair Refining Co.'s East Chicago refinery to adopt stringent measures.

The method they worked out identifies each plank and also prevents any one from sawing it in two. As shown in the sketch in Fig. 2, each plank is bound with a length of extra heavy wire running completely around its edge and ends. Identification is provided by painting the edges and ends in a bright orange.

If the man attempting to "borrow" the plank is color blind and doesn't notice the orange paint, he will have no luck in sawing because of the wire.

SMOOTH SAILING..

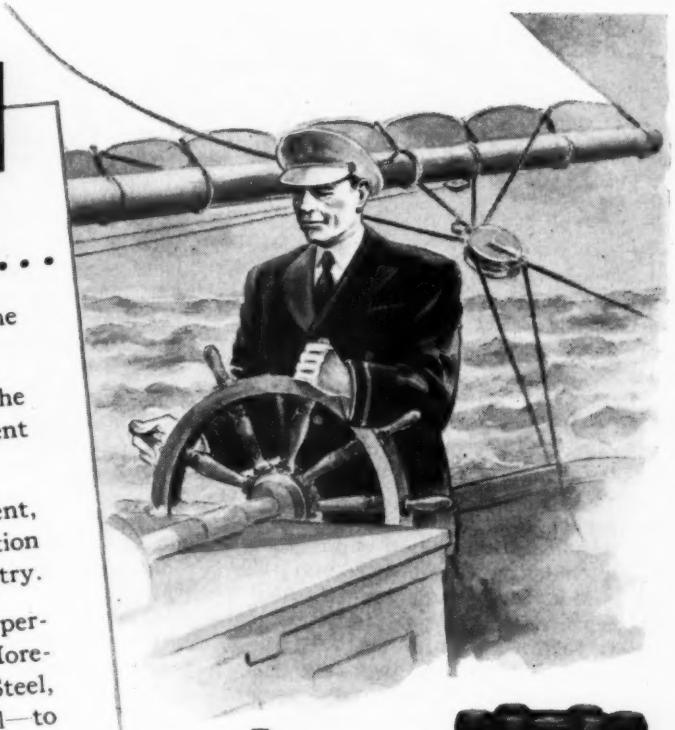
takes more than good weather and a fair wind...

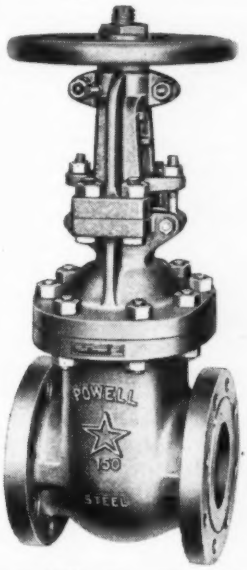
For smooth sailing depends to a great extent on the efficiency of the control exercised by the pilot.

Now in handling media in an industrial plant, the pilot is a valve and "smooth sailing" is dependent on the efficiency of its control.

And when it comes to flow control equipment, Powell Valves are making an important contribution to "smooth sailing" in every branch of industry.

Powell Valves are noted for long, dependable performance at a minimum cost of maintenance. Moreover, there's a Powell Valve—in Bronze, Iron, Steel, or any required Corrosion-Resistant material—to satisfy the demands of every known service.





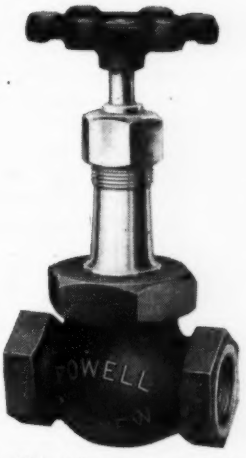


Fig. 190—150-pound Iron Body Bronze Mounted "Irenew" Globe Valve. Has screwed ends, union bonnet and regrindable, renewable wear-resisting "Powellium" nickel-bronze seat and disc.

Fig. 1503—Class 150-pound Cast Steel Gate Valve with flanged ends, bolted flanged yoke, outside screw rising stem, tapered solid wedge.

Fig. 1561—Class 150-pound Cast Steel Swing Check Valve. Flanged ends and bolted cap. The disc has ample lift to permit full, straightway, unobstructed flow through the valve body.

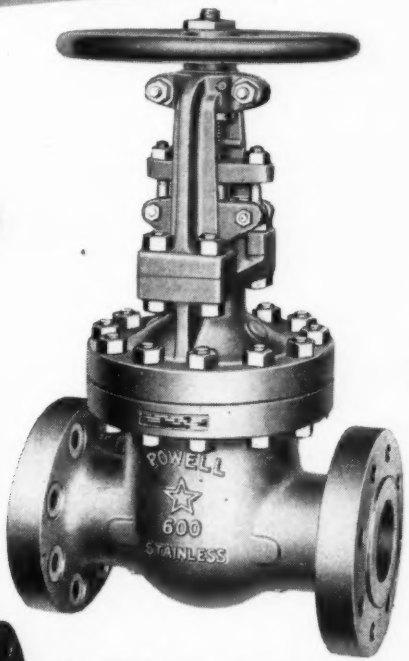
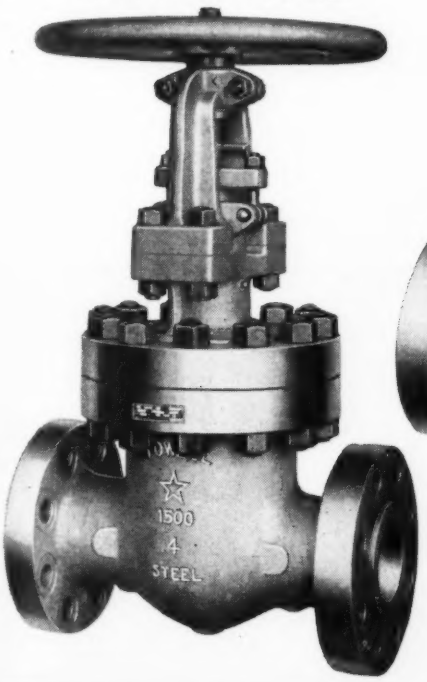


Fig. 6003 S. S.—Class 600-pound Stainless Steel Gate Valve with flanged ends, bolted flanged yoke, outside screw rising stem and tapered solid wedge.

Fig. 1303—Class 1500-pound Cast Steel Gate Valve with flanged ends, bolted flanged yoke, outside screw rising stem and tapered solid wedge.



The Wm. Powell Co., Cincinnati 22, Ohio

DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

POWELL VALVES

Monsanto Opens New Laboratory for Testing Fuel

NEW laboratory facilities for the engine testing of fuels and lubricants have just been completed at the Organic Chemicals Division plant of Monsanto Chemical Co. in St. Louis.

Principal responsibilities of the St. Louis laboratory will be in research, customer service, and production quality control. Research efforts will be in the development of new and improved additives for lubricating oils and in setting up new engine testing techniques, correlations and the like. Monsanto's customers will have the services of the new facilities to assist them as required in their development of better lubricants. Periodic re-testing of additives as a precautionary double-check on quality will aid in production control, even though plant laboratories elsewhere have all the facilities necessary for routine manufacturing control by means of chemical and physical tests.

Although the laboratory at St. Louis is new, Monsanto's activity in the field of engine testing is not. The company previously operated a similar laboratory at Nitro, W. Va., which has been relocated and expanded into the present new facilities. The St. Louis laboratory will be able to perform all normal evaluation tests on lubricating and gear oils except those designated by the Co-ordinating Research Council as L-19 and L-20, which relate to the road evaluation tests for gear oils.

The new facilities are housed in a partially air conditioned two-story brick building affording 10,000 sq. ft. of floor space. Special efforts have been taken to minimize vibration and silence engine noise. Equipment consists of 12 Lauson (Models H-2 and L-F) and 4 Chevrolet engines, two Caterpillar single-cylinder diesels (a third one, supercharged, is on order), bench test equipment, complete analytical laboratory, fuel and oil storage, engine overhauling and cleaning shop, and parts storerooms. Space has been left for several more test cells. Among principal bench tests are SAE and Almen extreme pressure testers, 4-square gear tester, and Underwood and McCool oxidation test machines. A staff of 30 will operate on a 24-hour, 7-day weekly schedule.

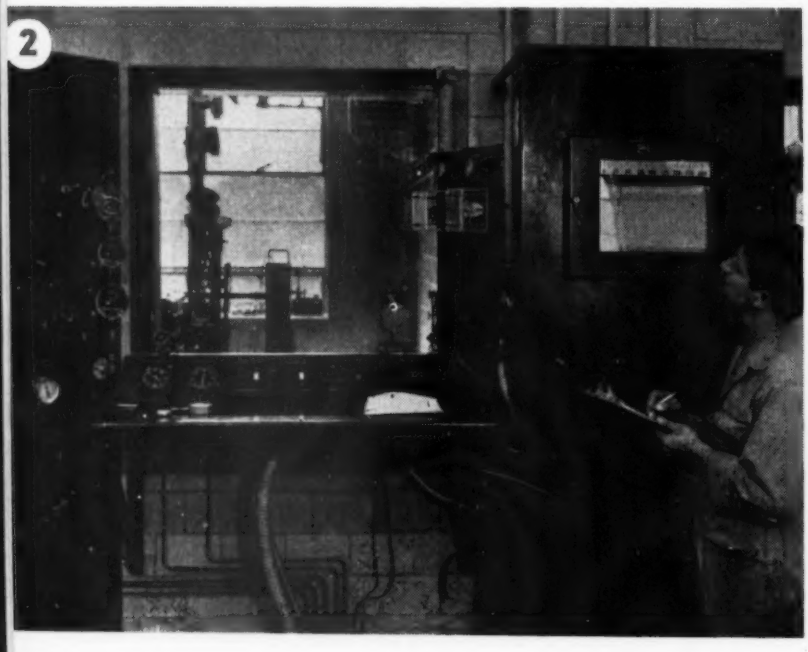
All engine testing is done on the first floor, with bench test rooms, chemical lab, offices and store-room on the second.

At present there are two Chevrolet test cells equipped with remote control operating panels. After final adjustments are made on the engine, the operator need enter the cell only for occasional checks of spark advance and cam angle, and to double check calibration of the electrical tachometer on the control panel.

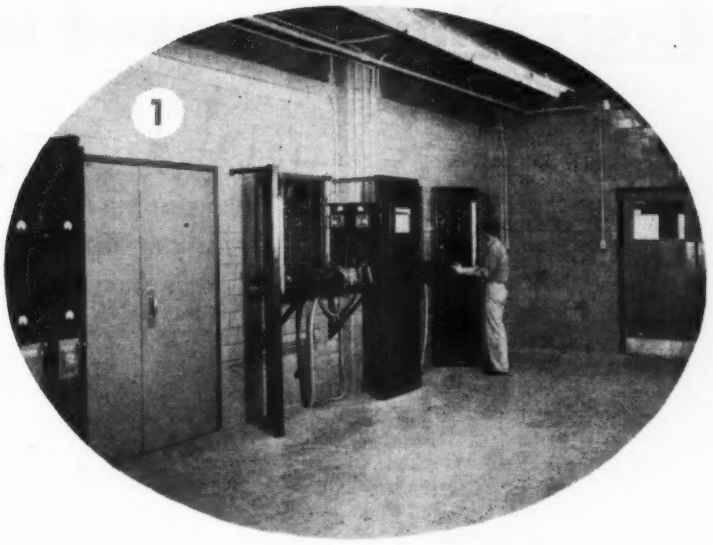
Fig. 1 shows a part of the first floor of the building, with Chevrolet engine test cells on the left and engine shop entrance at rear. Here the engine operator works in quiet surroundings, watching his engine as necessary through double glazed windows. Fig. 2 is a close-up of one of the remote control panels, showing differential pressure manometer, rotameter and fuel consumption instruments on left; oil and manifold pressure, room heater and exhaust fan controls, dynamometer beam "out-of-balance" warning signals, ignition, lever for hydraulic throttle control and tachometer, in center. Dynamometer loading rheostat and safety interlocking relays are at right, while temperature recorder is on extreme right. A portion of one of the test stands is visible through the window.

Safety controls to prevent engine run-aways are tied through the ignition switch. When ignition is "off", dynamometer is automatically unloaded and fuel supply valve closed. Should there be failure of 440 v. purchased power or laboratory-generated 250 v. D. C. and 6 v. D. C., engine automatically shuts down.

Test cell walls are constructed of Haydite concrete blocks to absorb noise. Engine is mounted on jackscrews, as can be seen in Fig. 3, supported on a 3-in. cast iron pad 5 ft. wide by 9 ft. long. This in turn is carried by a concrete block 5 ft. thick resting on 3 in. of cork at bottom and sides and supported by a monolithic pad running under that side of building. Engine jacket water is cooled by exchange with tap water; tap water also cools dynamometer. Engine exhaust is cooled by a fog noz-



tinuels, Lubricants



zle enroute to a plenum chamber under cell floor for muffling, then is piped under building walls to a stack. A monorail and hoist is used to move engine from dolly to test stand.

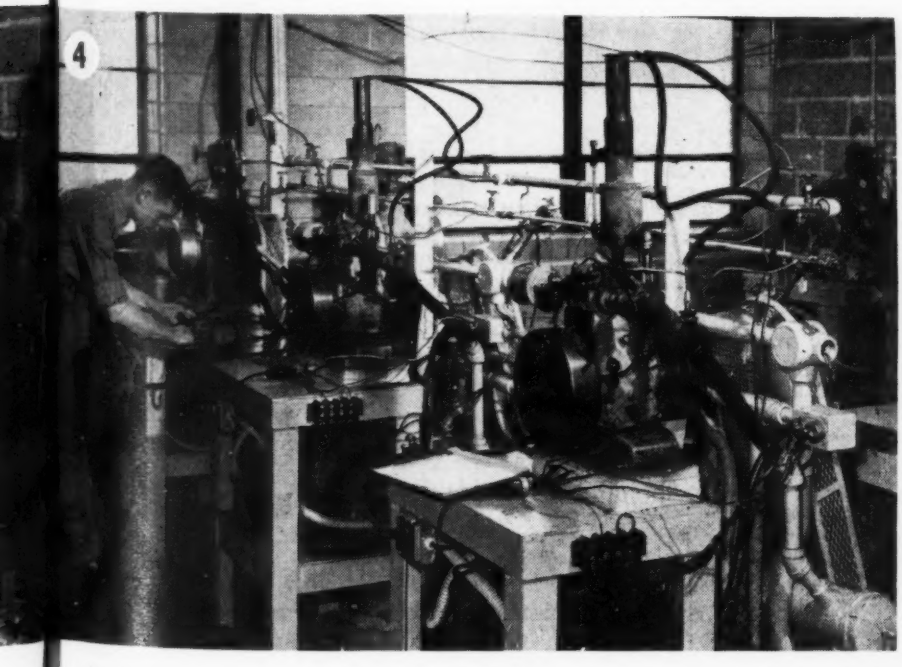
Lauson engines are mounted on individual steel test stands carrying a vibration-dampening pad, as shown in Fig. 4. Temperatures are measured by a recording potentiometer. Loading, equivalent to 1 hp. at the engine, is supplied by synchronous motors through a belt drive, preferred over direct-coupling because it reduces shock loading on crankshaft and misalignment problems. Also, lab's previous experience has been at 600 rpm. speeds, further necessitating a belt drive to compensate for the different speeds of engine and motor. Engines exhaust into one of three headers which absorb the noise; atmospheric pressure at individual engine exhaust ports is maintained by aspirators atop the exhaust stacks outside the building, which compensate for effects of friction in the long pipe.

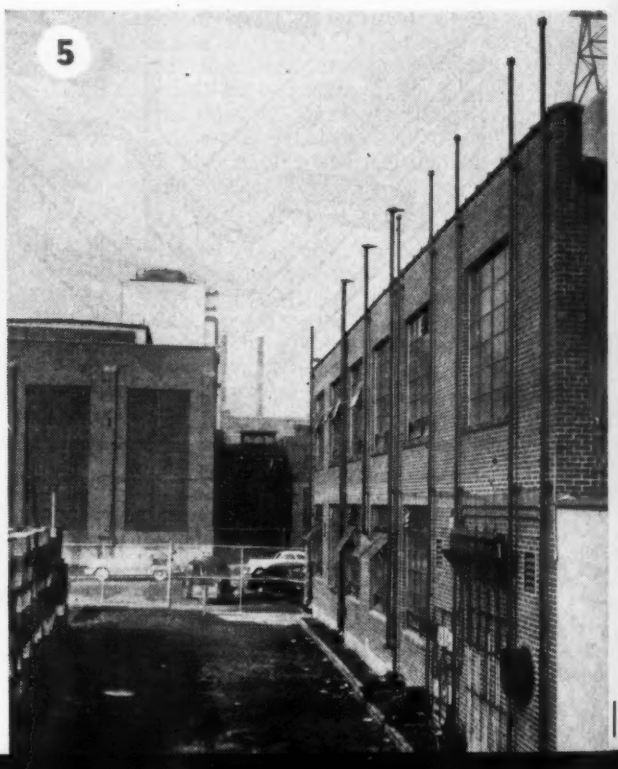
The Diesel test cell is similar to Chevrolet cell except that engine is bolted to the cast-iron pad through steel channels. Remote control panel is not used since constant operator attention is unnecessary. Exhaust is carried overhead through a flexible pipe, and then handled same as in Chevrolet cells.

Fuels are stored in five underground tanks outside the building. Three 2000-gal. tanks and one 1000-gal. tank are reserved for gasoline; one 1000-gal. tank holds Diesel fuel. On side of building, Fig. 5, may be seen the five fuel pumps loading the small head tanks above. Overflow from the head tanks returns to storage. Head tanks feed four individual headers circling the building, from which lines are taken under the building walls to the individual test cells. Diesel fuel header leads only to the two Diesel test cells. "Pistols" on top of three stacks on side of building are aspirators on Lauson exhaust stacks; line at front is exhaust from a Diesel test cell, and other five lines are fuel tank vents, to which head tanks also are vented. Lube and additive stocks are stored in barrels and drums.

The complete analytical laboratory includes equipment to run such physical and chemical tests as viscosities, neutralization number, Conradson carbon, pour test, sulfate and ash. The laboratory also is responsible for the preparation of all special blends of lubricant stocks, whether in large or small quantities, which may be required. For relatively large quantities, usual practice is to use a circulating pump taking suction off the bottom of an elevated barrel, discharging into the top.

Completing the facilities are separate engine tear-down and inspection rooms, with appropriate tools. When an engine is removed from the test stand, it is placed on a special dolly which permits it to be rotated to any desired position for convenient work. Parts removed are placed in containers for inspection, and taken to the inspection room which has North light in addition to usual artificial illumination.





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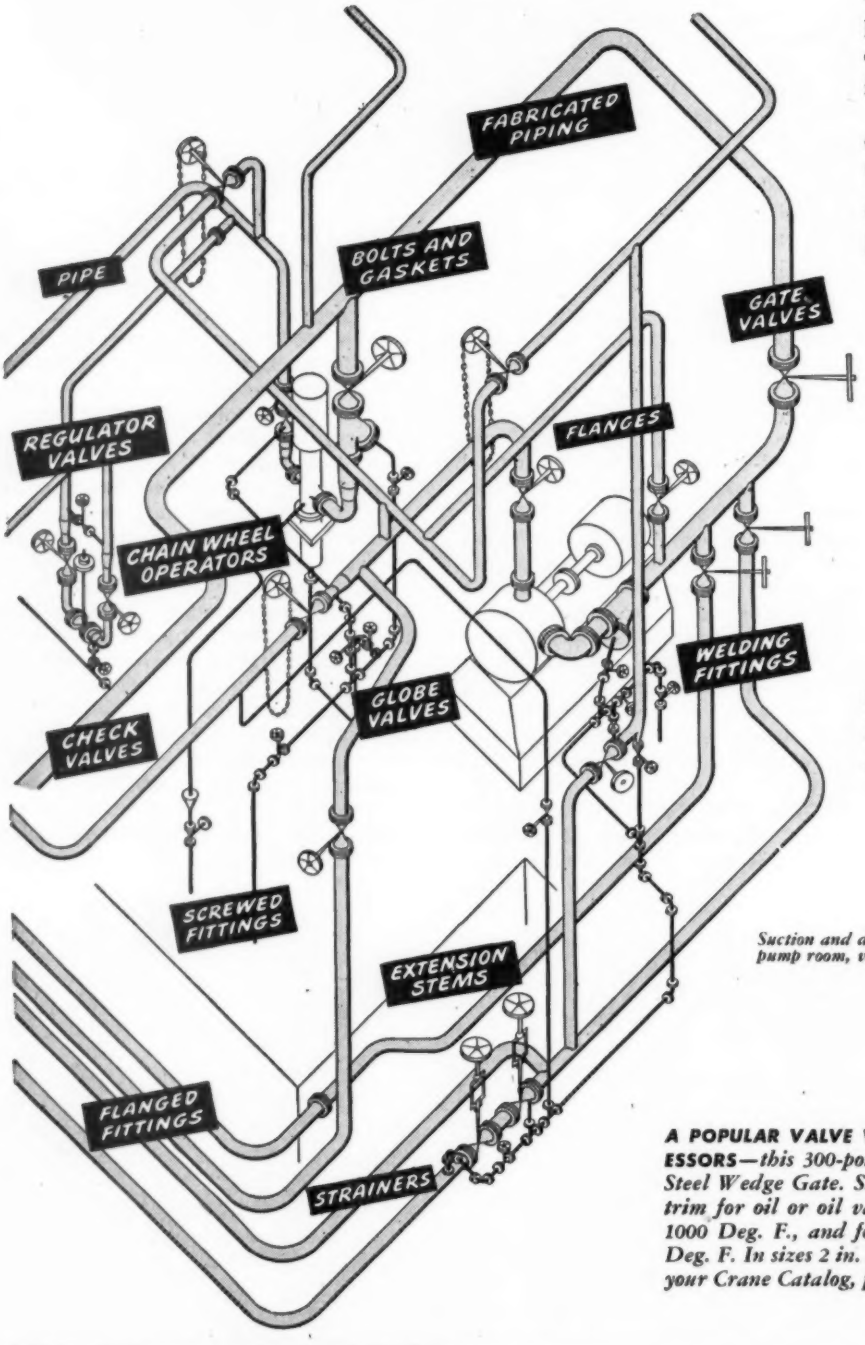

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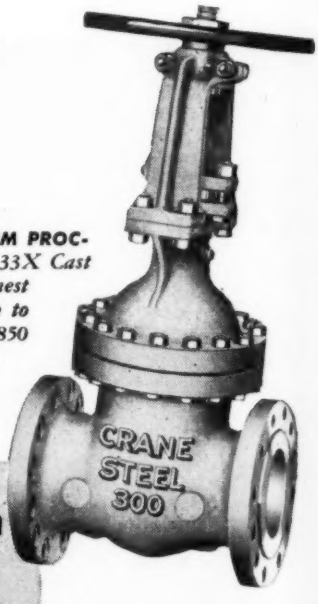

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QUESTIONS and ANSWERS

Gasoline and Cycling Plant Operation

Conducted by DAVE THORNTON

From a recovery standpoint, what is the most important single item in natural gasoline plant operation?

Assuming a new plant, in which high recovery of butane and propane is attempted, certainly high recovery will not be maintained unless particular attention is paid to the condition of the absorption oil. That probably enters into the matter before anything else. To have high recoveries of propane or butane it is absolutely essential that the oil be kept in good shape—of proper boiling range and average molecular weight, free of foreign matter and dirt, or sludge. This requires particular attention in the design of a reclaimer, and that reclaimer must work at all times. None of us want to circulate 600 gpm. of oil with 10 to 15% of it not being any good.—M. R. Church, Gas-Gasoline Dept., Shell Oil Co., Inc., Houston.

We have had considerable trouble with wear and sticking of our positive displacement meters at our truck loading rack. Are conventional strainers supposed to handle all types of solids and also remove the water which seems to cause most of our corrosion and meter stoppage?

Conventional basket, or felt type, "strainers" are limited in filtering efficiency to the net area of the screen mesh or felt exposed to the flow of product. Most strainers are designed to provide only 5 to 10 times the area of the pipe diameter. In the case of fairly dirty streams, this type of strainer often fills up the 80-mesh to 120-mesh screen in such a short time that operators have been known to remove the baskets entirely because of the trouble of frequent cleaning.

Where a combination problem of complete water removal and the filtration of product streams down to 10 microns is present, it is now possible to employ "three-stage" filtration and water separation in one integral unit.

The first "stage" removes all large pipe scale and, in general, sediment easily visible. The second then removes the finer sediment down to and including particles approximately 40 microns in diameter—or practically to the lower limit of visibility with the naked eye.

The second stage also acts as a water coalescer and precipitates the most finely divided gasoline water emulsions so that the water may be easily trapped out. The gasoline, or light product, is delivered approximately 100% free of entrained water.

The third "stage" of filtration employs nests of resin-impregnated-paper filter elements having a very large net surface area. For 300 gpm-streams, the third stage filtering area provides 188.9 sq. ft.—almost 2200 times the pipe area.

Thus, it now is possible to remove both water and debris in any light product stream (also incorporating air elimination, if desired) and stop practically all meter wear and corrosion due to these sources.—W. A. Gresh, Warner Lewis Co., Tulsa.

> Data in answer to questions presented on these pages is supplied through the cooperation of authorities with the equipment and engineering companies of the Natural Gasoline Supply Mens Assn., among others. Readers are invited to submit queries on plant operating problems in their own work.

What will be the effects if the crankcase breather of an engine is connected to the air intake system?

It is general practice among engine builders to provide a crankcase breather to ventilate the crankcase, thereby disposing of moisture and any blow-by gases or other products of decomposition which may form or enter the crankcase. The breather is open to the air for this purpose.

Often, however, operators will attempt to improve on the engine design by connecting the breather to the air intake system, under the mistaken impression they are providing upper cylinder lubrication to the engine.

Actually this is not what happens at all. There is little or no lubrication value in crankcase breather vapors. Instead, most air is drawn in over the piston and any products of decomposition which may be present or form from this moisture-laden vapor will deposit on the piston and combustion chamber walls. Also, the vapor will have a tendency to drive lubricant away from the piston and walls; piston or cylinder scoring, or both, follows. This last result often is blamed on the lubricant or the lubrication system instead of the true cause. This is a bad practice, unfortunately too frequently encountered.—Max E. Landry, Bruce-Macbeth Engine Co., Tulsa.

What concentration of odorant is required for odorizing butane for domestic use, and how much should be used per 1000 cu. ft. of natural gas to give unmistakable indication of a leak around such public buildings as schoolhouses?

One pound of ethyl mercaptan, or the equivalent, to every 8000 gal. of propane or butane is sufficient to produce what is termed a "Degree II" odor. For natural gas the requirement is 1 lb. of ethyl mercaptan per 1000 Mcf. to produce a Degree II odor. This means that there will be a faint but unmistakable odor when one-half of 1% of liquefied petroleum gas is present, or 1% of natural gas. In each case, the gas concentration will be one-fifth of the lower explosive limit in air when the odor is noted, while conditions still will be safe for application of remedial measures without hazard of explosion.

The degree of odorization mentioned above originally was worked out by the Bureau of Mines in 1930 and published in a now out-of-print Monograph No. 4 entitled "Warning Agents for Fuel Gases." In this a "Degree I" odor is classified as very faint and at the threshold of odor detection for the ordinary person. "Degree II" is very faint, but unmistakable; "Degree III" as "unpleasant" and "Degree IV" is listed as "unbearable." While there is a "Degree V", the nose cannot differentiate between this and Degree IV.

There is no harm in odorizing to a greater extent than required to

produce Degree II, but the practice is unnecessary with the fuel gases.

When rating other odorants, reference should be made to the more precise definitions of the five classifications in the monograph cited.—C. E. Gill, Natural Gas Odorizing Co., Inc., Houston.

What is the general cost figure for installations of high pressure natural gas reciprocating compressors? Average annual maintenance cost?

The cost will depend entirely on the type of equipment to be installed, speed involved, etc. With high speed units installed horsepower cost is less than with the slower speed horizontal compressor units. In pipeline installations of the horizontal type we have run into extremely high costs of late, based on present material costs, labor costs, and the like it has run as high as $208 per horsepower installed. There is a possibility of $150 per installed horsepower on the higher speed angle-type compressor units.

This is a very difficult figure to give, due to the fact that various operators treat their equipment in an entirely different manner. Some operators go as low as 50c per year per installed horsepower on maintenance, and other have gone as high as $1 per installed horsepower. In addition, there is the fact that the determining factor is the age of your equipment in hours in service.—J. B. Zachry, Worthington Pump & Machinery Co., Tulsa.

How can polymers or other deposits from hydrocarbons be removed from the heat exchangers, coolers and tube bundles? Is burning or use of solvents the better method?

The best procedure depends upon conditions and objective. Something can be said in favor of each method.

For instance, if the object is the cleaning of an oil heater which has long been neglected, so that extremely high polymers have been laid down which would be relatively insoluble in even carefully-selected solvent, or if the oil has been partially or fully carbonized, which would again render removal by solvent action difficult or impossible, then obviously the best and perhaps the only procedure would be to remove the bundle and burn out the accumulation.

On the other hand, if the polymers, waxes, asphaltics and the like still are in a state where selective solvents will exert a good solvent or dispersing action upon them then, without doubt, the use of solvent would present a more efficient, effective and easier way to remove the objectionable accumulations.

Solvent action in certain pieces of equipment can be made more economical than is possible by filling the entire piece of apparatus with relatively expensive solvent if by careful selection and balance of specific gravity it is made possible to circulate it in a water medium. This method requires for best efficiency the action of a solvent which subsequently can be emulsified and the entire mass of solvent input and water thoroughly flushed from the system.

This method of cleaning, while effective and economical, lends itself for use only in that type of equipment that is reached in all its parts by the circulation. Naturally if there are any circulation niches the solvent would not be carried to these sections and as a consequence they would not be cleaned. In such cases the only alternative would be flushing the entire system with concentrated solvent.

Burning is laborious and cumbersome and cannot be practiced where shells and similar heat transfer surfaces are encountered. Such items are best cleaned by scraping if badly fouled.

Thus it is apparent that no generalization can be made as to the best method of cleaning a fouled system. However, it can be safely stated that the best all-around procedure is to subject systems of this kind to periodic solvent treatment to prevent conditions becoming so bad as to require removal by burning. It is the old story of the ounce of prevention. By the same token, regular treatment of the oil and hydrocarbon with suitable additives to reduce polymerization, etc., is a good precautionary measure to maintain efficient operation of coolers, heat exchangers and heaters, and at the same time make for better and more efficient use to which the oil is put.—R. W. Kendrick, Gulf Engineering Co., Inc. New Orleans.

What is the best fire protection system for enclosed natural gasoline plant areas where a fire hazard may exist through accumulation of inflammable vapors near the floor—such as pump rooms, compressor houses and the like?

There are several methods of extinguishing fires developing from inflammable vapors or liquids on or near the floor. The most ideal means, and also the most expensive, is the use of an automatic system dumping carbon dioxide into the area, thus snuffing out the fire. This has the advantage of requiring no personnel to be present during the operation and does not add to the debris which must be cleaned up afterwards. Systems are available which will shut down engines or pumps, close all windows and doors and sound an alarm before drenching the area with carbon dioxide.

In designing such a system, one 50-lb cylinder of CO_2 must be provided for each 1000 cu ft. of space, and cost will average about $200 per cylinder. A 10-cylinder system, costing $2000, is considered rather small as such plant areas go.

A less expensive but still satisfactory method, relatively new to the oil industry, is the use of the "DuGas" extinguisher, which discharges a dry powder into the fire. The powder is largely sodium bicarbonate, expelled from portable, wheeled or truck-mounted extinguishers by carbon dioxide or nitrogen from a self-contained cylinder. The high pressure of the gas and lightness of the finely divided powder combine to provide a good effective range for the extinguishing agent and safety for the operator. Pound for pound, the DuGas unit will extinguish more fire than will CO_2 and may be used anywhere in the plant or home with safety. Unfortunately, no satisfactory method has been devised for installations of permanent or automatic DuGas systems. Several sizes of extinguishers are available. The residue may be cleaned up by sweeping or with water, similar to the residue from a foam system.

Still another available method quite commonly provided in enclosed areas is the portable CO_2 extinguisher, with which most plant personnel are familiar. Mechanical and chemical foam units and systems also may be used, but dry powder units or CO_2 systems are much more satisfactory, especially where vapors are involved.

One of the best systems for the electric powerplant or substation is carbon tetrachloride, stored under pressure in hand-type extinguishers. This extinguisher has two cylinders, one containing a gallon of the chemical and the other air at 100 psi. Outlets of both cylinder and the nozzle are operated simultaneously by a single motion of the trigger; when the chemical is exhausted the air cylinder still contains air at 45 psi. This type is especially recommended for electrical fires because it has a good effective range and permits the operator to remain far enough away from the arc to avoid contact with the ionized air area which always surrounds it. Air leaving the extinguisher after the chemical is exhausted also serves to blow the arc away from the operator.—J. A. Harte, American LaFrance Foamite Corp., Tulsa.

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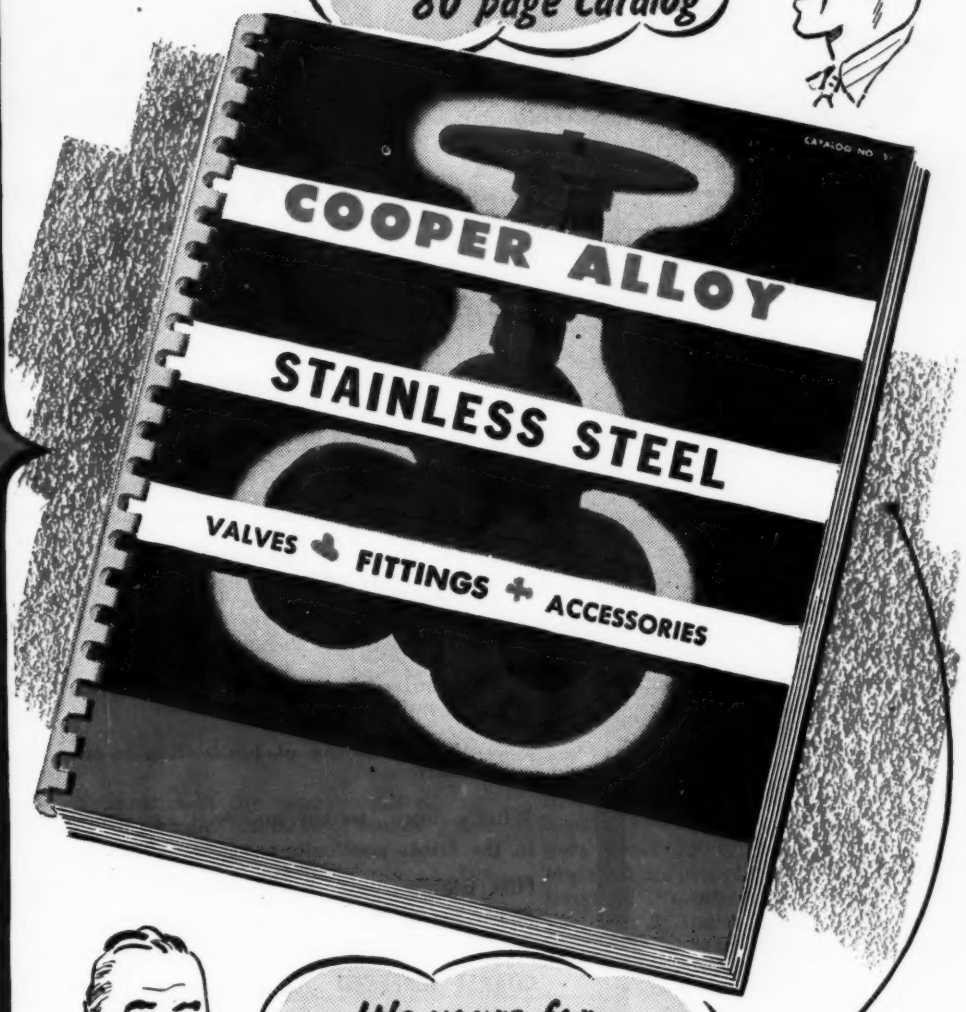

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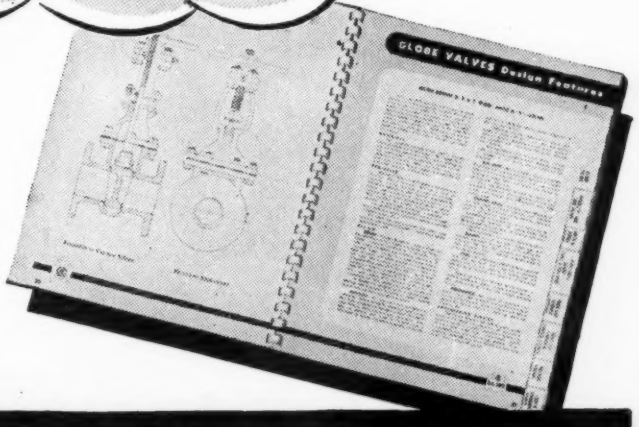

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Wooden Clamps Reduce Breakage, Stop Injuries When 'Lab' Glassware Is Being Assembled

A SET of the simple devices illustrated in the accompanying drawing, Fig. 1, increases safety and reduces breakage when inserting thermometers in corks and placing corks in and on distillation flasks at the Baytown refinery laboratory of Humble Oil & Refining Co. Two pieces of wood approximately ¾-in. thick, some felt and a pair of hinges are required for each clamp, and as many are made as necessary to fit the various sizes of flasks and thermometers customarily carried in stock. The principle also may be adopted for handling other glassware.

An outline of the neck and side-arm of the flask is drawn on each of the two pieces of wood, adjusting the pattern so that approximately 1 in. of the top of the flask neck is left exposed, and about 1½ in. of the side-arm. The wood blocks are hollowed out to take the neck and side-arm, the depression finally being covered with thin felt. This provides some "spring" but permits gripping the flask firmly. Hinges are attached along one edge of the block. For thermometers, only a single groove is required on each block, deep enough when covered with felt to permit a tight grip on the thermometer. Corks are installed in the apparatus in the usual manner.

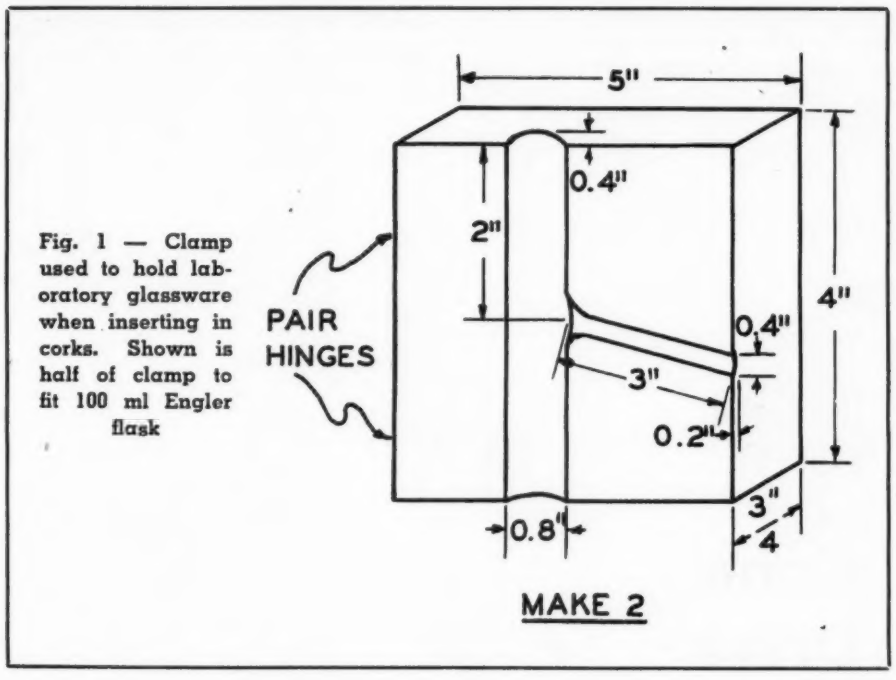


Fig. 1 — Clamp used to hold laboratory glassware when inserting in corks. Shown is half of clamp to fit 100 ml Engler flask

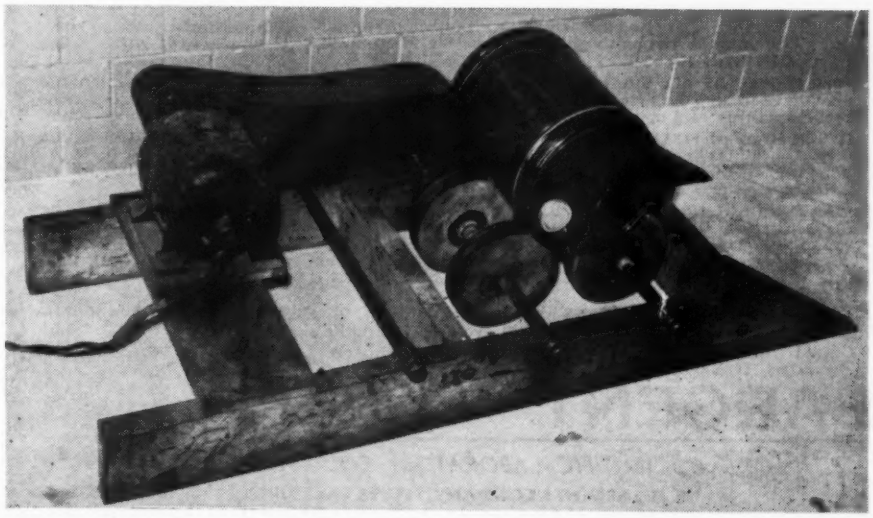
Since only an inch or so of glass projects from the block on the side where the cork is being placed, the glass usually is sufficiently strong to withstand safely the twisting and lateral pressure ordinarily required to position the cork. Should the glass break, however, the operator's fingers most likely to be injured are engaged in gripping the block, while those of the other hand are gripping the cork in the direction of pressure, hence both are comparatively safe.

Power-driven Roller Device Assures Fast, Thorough Mixing Of Engine Laboratory Blending Stocks in Monsanto Plant

IT IS OFTEN desirable to be able to mix stocks while the components of the blend are in a barrel, drum, or can. One way, of course, is to close the container and roll it around until a homogeneous mixture is obtained. Usually space is inadequate for this purpose and, with large containers, two or more men may be required for the rolling.

Technicians at Monsanto Chemical Co.'s engine testing laboratory in St. Louis have a "Rube Goldberg" which does this job thoroughly without operator attention for as long a time as is needed. It will take containers from 5 gal. cans up to 42-gal. oil barrels with equal ease.

As shown in the photograph, the maple frame is assembled from two 2 x 6 in. planks with another two planks acting as cross members. A ramp is provided at one end to roll



Rolling device provides adequate mixing for samples in containers ranging from 5-gal. cans to 42-gal. barrels

the barrel up onto the device. The weight of the assembly is sufficient ordinarily to prevent slippage when placing or removing a large barrel; however, the mixer may be bolted to the floor for complete safety.

Motive power is provided by a half-horsepower electric motor, turning at 1725 rpm., through two pairs of 3 to 10 in. pulleys. This provides approximately 150 rpm on the first set of 10-in. wooden wheels, which are carried on a one-in. steel shaft. The second set of 10-in. wheels is not driven.

Usually 30 minutes of rolling on this device is sufficient for satisfactory mixing, Monsanto engineers have found.

Check Need for Coke Cleanout By Modified Distillation Test

A SIMPLE and proved method for determining when cracking units need to be shut down for coke cleanout has been developed and is used by chemists at Sinclair Refining Co.'s East Chicago refinery.

It is based on a modification of the ASTM Method of Test D158—41 for *Distillation of Gas Oil and Similar Distillate Fuel Oils.* The apparatus used is the same as in D 158.

As followed in modified form: A 100 ml. sample of oil from the unit —any feed stock or recycle oil—is measured into a weighed Saybolt distilling flask and the weight of flask and sample carefully obtained.

The flask is then hooked to the condenser and a cork stopper placed in the neck instead of the usual one-holed stopper with thermometer. The sample is then distilled off to the end point at a rate of not less than 4 nor more than 5 ml. per minute. The burner is then turned up to "full throttle," heating the flask to cherry red, including the neck and discharge tube. (In most cases the flask will become deformed and must be discarded at the conclusion of the test.)

Following this, the flask is cooled and weighed. Coke percentage is equal to weight of residue in flask times 100 divided by the weight of the sample.

Sinclair has found through experience that when the coke content exceeds a certain established percentage (about 0.25) the unit from which the sample was obtained will have to come down for cleanout. They have found that if coke content is plotted against time with tests being run at uniform intervals, the curve will be a gradual one until it reaches this particular level, then it rises rapidly.

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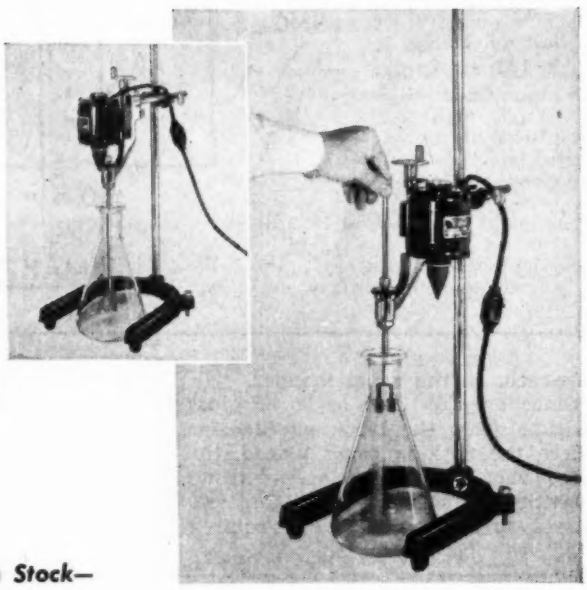

In redesigning the Sargent Cone Drive Stirring Motor, the basic form, size and characteristics, including the method of transmitting power by means of a driving cone and a driven ring have been retained because of definite advantages they have displayed over other types of stirring apparatus during many years of proven performance in the field. However, now, certain mechanical inconveniences in manipulation which formerly existed, have been eliminated and the efficiency and ease of operation greatly increased.

NEW MOTOR MOUNT—The motor is mounted on a threaded rod and urges the driving cone against the friction ring by means of a pressure plate with adjustable spring tension. This type of mounting permits the motor to be swung away and held in a free positin without changing the lateral position of the chuck. For additional convenience, the motor may be swung to either side of the friction ring, from where it will operate with equal efficiency.

FULL POWER AT ALL SPEEDS—The patented Sargent cone-to-ring device in which the driving cone and the driven ring rotate in the same plane, reduces cross-drag to a negligible quantity and delivers full power to the chuck at all speeds from 75 to 1300 r.p.m.

CHUCK HELD IN FIXED POSITION—The speed is varied by turning a hand wheel which raises or lowers the motor and alters the position of the cone with relation to the friction ring. In this type of design the ring and chuck are held in a fixed position and all lateral movement is in the cone and motor.

FEED-THROUGH SPLIT-COLLET CHUCK—Another feature of the new model Sargent Cone Drive Stirring Motor is the feed-through split-collet chuck which permits the stirring rod to be removed from the vessel in which material is being stirred, without repositioning the motor on the support rod. To accomplish this, merely swing the motor to one side, loosen the chuck and raise the stirring rod out of the vessel through the open top of the chuck.

S-76445 STIRRING MOTOR, Electric, Sargent Cone Drive, Variable Speed, Patent No. 1,973,-576. For operation from 115 volt 50/60 cycle A.C. circuits.....$45.00

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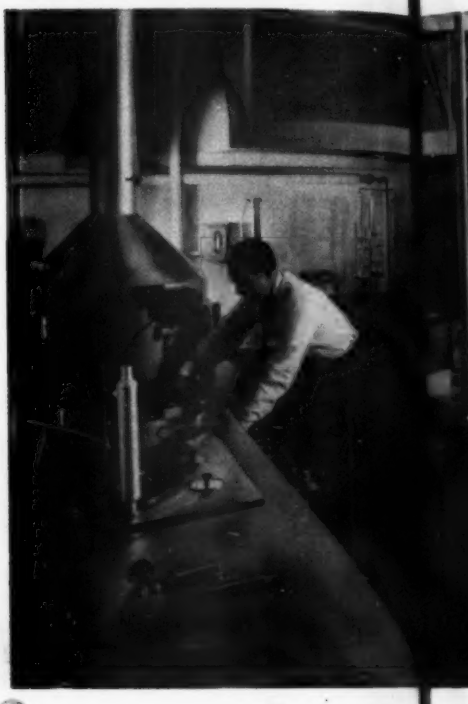
This well-equipped field laboratory services many of the large and small refineries in the area. Another part, not shown here, is equipped for making octane number determinations.



These 5 strategically located laboratories offer friendly cooperative help to refineries everywhere

IN CHICAGO

Du Pont's laboratory is convenient to the refineries located in that area. It is equipped to make octane number evaluations, as well as the many other tests necessary to a complete service.

IN WILMINGTON

This field laboratory serves the Engineering Laboratory, as well as Du Pont's eastern road test facilities. Its extensive equipment and highly-trained personnel can carry out the most complicated work.

IN EL MONTE

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IN HOUSTON

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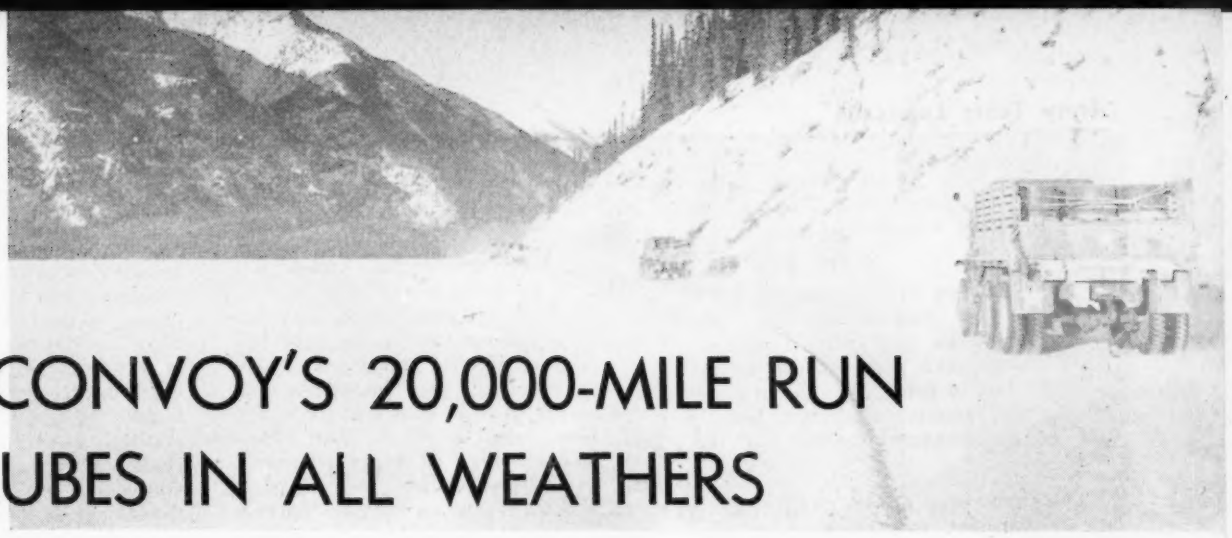

ARMY CONVOY'S 20,000-MILE RUN TESTS LUBES IN ALL WEATHERS

By COLONEL G. H. VOGEL
Military Services Petroleum Board, Washington, D. C.

Our military forces require automotive lubricants which will function with a minimum of modification or adjustment within an ambient temperature range of +125°F. to −65°F. A 20,000-mile road test by an Army convoy will service test lubricants under extremes of temperature. Turboprop engines provide the most stringent requirements of any aircraft power plant on a lubricating oil. Synthetic greases for aircraft have been found to exhibit low torques at low temperatures but may need improved wear characteristics and extension of their high temperature range to make them universally applicable.

The accompanying paper was presented by Colonel Vogel at the meeting of the Lubrication Committee of the American Petroleum Institute, Tulsa, April 28, 1948. The text, while unchanged, is in slightly different order than in the original paper.

DURING the winter of 1946-47 it became evident to the Army that their military equipment, using specified lubricants according to issued instructions, could not operate successfully below −40°F. A meeting of key personnel from refining and manufacturing companies and representatives of the Ordnance Department was called to discuss the requirements for lubricants that would permit operation of military equipment at temperatures down to −65°F.

Adequate quantities of each special lubricant selected by this committee were manufactured and forwarded to Aberdeen Proving Ground and screened for performance in military equipment at the then prevailing temperature of 60-70°F. Sufficient quantities of the remaining lubricants and the necessary transport and combat vehicles were then forwarded to Eglin Air Base, in Florida, and evaluated in the climatic hanger by testing the operation of the equipment under Arctic temperatures.

Upon completion of these tests, supplies of the acceptable products were immediately shipped to Alaska and issued to the entire theater for general field test use. Field tests were under the constant supervision of the Ordnance Department and leaders of industry working under the auspices of the Coordinating Research Council, who alternated as observers and advisors.

After approximately 6 months operation of the equipment over the entire theater, at temperatures ranging down to −45° F., a convoy of vehicles was assembled and driven from Alaska to the Detroit Arsenal. Some of the convoy vehicles were serviced with regular lubricants and the remainder with the low temperature products. Final inspection of the vehicles revealed that the performance of the Arctic fuels and lubricants was satisfactory. The result of these tests will provide information to the military services and industry which will enable them to materially improve the operation of military equipment under extreme low temperature conditions.

While the initial information indicates that the performance of these special lubricants is generally satisfactory, considerable additional effort will be required before a final solution of the problem is obtained.

The military forces have placed a requirement on their material that it function with a minimum amount of modification or adjustment within an ambient temperature range of +125° F. to −65° F. It has been found that a task force moving into an area of either extreme requires considerable time for preparation and change-over to lubricants for the particular climate. This reduces maneuverability and imposes an intolerable load on maintenance facilities. During the course of developing lubricants for Arctic use, greases have been developed which indicate they will perform satisfactorily over the entire temperature range.

To service test these lubricants, screen them, and verify their suitability, a 20,000-mile road test will be carried out. A convoy is scheduled to leave the East Coast in August, operate several thousand miles in the western desert, then proceed to Alaska by way of the Alcan Highway for winter operations and return to the states for final inspection.

Additional materials to be tested may include tires, brake linings, sealed brakes, spark plugs, fan belts, brake fluid, and others. All technical aspects of this convoy operation are under the jurisdiction of the Ordnance Department of the Army, assisted by the Coordinating Research Council. This Army-Coordinating Research Council team is one of the outstanding examples of military-industry cooperation.

The U. S. Air Force and the Navy Bureau of Aeronautics require that their aircraft have an ambient temperature operating range from −65° F. to +165° F.

Reciprocating aircraft engines operating at the higher temperatures utilize aviation lubricating oil Grade 1120. Grade 1100 is generally used for cold weather operations with the oil viscosity requirements for satisfactory starting being met by dilution with aviation gasoline.

Operation of aircraft with reciprocating engines could be greatly facilitated if one grade of oil were

developed that would permit satisfactory starting and operation through the required temperature range.

Turbo-jet engines require a very low viscosity lubricating oil. The lowest viscosity petroleum oils now being used have pour points below −65° F. but in some installations the oil is too viscous to permit pumping at temperatures below −40 to −50° F.

The turbo-prop engine provides the most stringent requirements of any aircraft power plant on a lubricating oil. This engine has the basic turbo-jet engine lubrication problem in the power section with the added requirements for lubricating reduction gears transmitting tremendous power.

A high viscosity index, low pour point oil is desired for lubrication of the turbo-jet and turbo-prop engines and for the latter extreme pressure qualities are required. For either power plant, dilution is not desirable due to the exceeedingly low heat rejection to the lubricating oil.

Research will be continued until more desirable lubricants are developed for all aircraft engines. For the turbo-jet and turbo-prop engines the application of synthetic oils appears promising.

Extensive research is being conducted by other branches of the military services on lubricants. This work ranges from development work dictated by needs revealed during World War II to fundamental research. Substantial improvements have been made in the development of low temperature lubricants with decreased torque requirements at temperatures below −40° F. lower evaporation rates, and improved storage stability. The Naval Research Laboratory reports that excellent low temperature greases can be prepared from diesters, silicones and silicone-diester mixtures, thickened with lithium stearate. These greases exhibit extremely low torques in anti-friction bearings at temperatures as low as −100° F. and remarkably low evaporation rates at moderately elevated temperatures. This work led to the specification AN-G-25, a potential universal grease, possibly requiring some improvement in wear characteristics and an extension of the high temperature range to make it the truly universal grease for aircraft.

The Naval Research Laboratory, conducting research sponsored by the Bureau of Ordnance, has developed an oil and a grease for fire control instruments from diesters. These lubricants with improved stability will permit satisfactory performance over a wide temperature range for some fire control instruments. Research will be continued to improve their performance characteristics.

The Ordnance Department, Department of the Army, has under way research projects to develop one instrument oil and one grease that will assure maximum performance of fire control instruments and Signal Corps aerial cameras and meteorological equipment over a temperature range of −65° F. to +160° F., and which will possess high stability for service conditions. The Air Materiel Command, U. S. Air Force, states that for the immediate future, grease lubrication of aircraft will be limited to 4 greases that overlap sufficiently within their performance ranges to take care of all present requirements and almost any eventuality in future designs.

Equipment supplied by industry to the military is serviced by the manufacturer with lubricants fully meeting the requirements of the service involved. It is mandatory that as the needs of the services develop, industry be given complete information concerning them so that satisfactory products may be developed. This makes the exchange of information between the military services and industry increasingly necessary, a procedure which will result in increased availability in case of emergency.

The military service grease requirement for the fiscal year of 1949 is approximately 10,000,000 pounds. The actual consumption will be above that estimate as considerable stocks of some types are on hand. The grease requirement for Civil Affairs for the same period is estimated at 12,000,000 pounds.

The grease manufacturing capacity is apparently adequate. The supply of some materials required for specialty greases may not be. The military services have experienced difficulty in obtaining from industry adequate coverage for their requirements of small quantities of special oils and greases.

Industry should appreciate the military position regarding these comparatively small volumes of special products. The requirements have been established through extensive research and sufficient quantities must be available to successfully operate the equipment for which they were developed.

The degree or extent of deterioration of stored lubricants and greases should be determined for each product under varying atmospheric conditions. This change with length of storage should be ascertained and its effect evaluated in terms of usability. This basic information should be provided for all petroleum products and synthetic lubricants to allow the military services to stockpile as dictated by needs, products availability and transportation.

Gummy deposits resulting in ring-sticking prompted research that developed additive type oils for use in Diesel engines. These additives include oxidation inhibitors, corrosion inhibitors, compounds for improving the lubricity of the oil, compounds for improving the low temperature characteristics and detergents which resists the formation of insoluble sludges. The development of the "vapor phase" or high temperature system of cooling Diesel engines, higher speed for all applications, the combination Diesel gas-oil engine, synthetic Diesel fuel oils, the utilization of heavier Diesel fuels, of higher sulfur fuels, and keeping engines warm by idling at Arctic conditions—all of these and other conditions and developments make it mandatory that the present requirements for Diesel lubricants be continually re-evaluated.

The present effective refining capacity for lubricating oil in the U. S. is approximately 150,000 b/d. Under construction are solvent extraction and solvent dewaxing units with an estimated output of 40,000 b/d. Some of this newly constructed capacity will undoubtedly replace present operating units, but the total effective capacity by 1950 should be adequate for our peacetime requirements.

The requirements of the military services and other Federal agencies for all lubricating oils for the fiscal year 1949 are approximately 1,300,000 bbls. or roughly 3600 b/d. In an emergency this requirement would probably be increased 5 times and depending on the ability of industry to produce war material requiring lubrication, this daily consumption might reach 36,000 bbl. of lubricating oil.

These figures do not include the Civil Affairs requirements for Europe and the Pacific, which are estimated at approximately 700,000 bbls. for the fiscal year 1949.

The availability of the most desirable crudes for the manufacture of lubricants is an increasing problem. Plans for the future must include consideration by the refiners of transporting desirable crudes from longer distances, and of processing less desirable crudes, resulting in lowered yields for a given charge capacity.

Any material increase in consumption by the military services must be met by one or a combination of the following:

a. Increased efforts to make available additional quantities of desirable and usable crudes.
b. Operation of all refining capacity at the maximum rate possible.
c. Reduction of civilian consumption.
d. Expansion of refining capacities.

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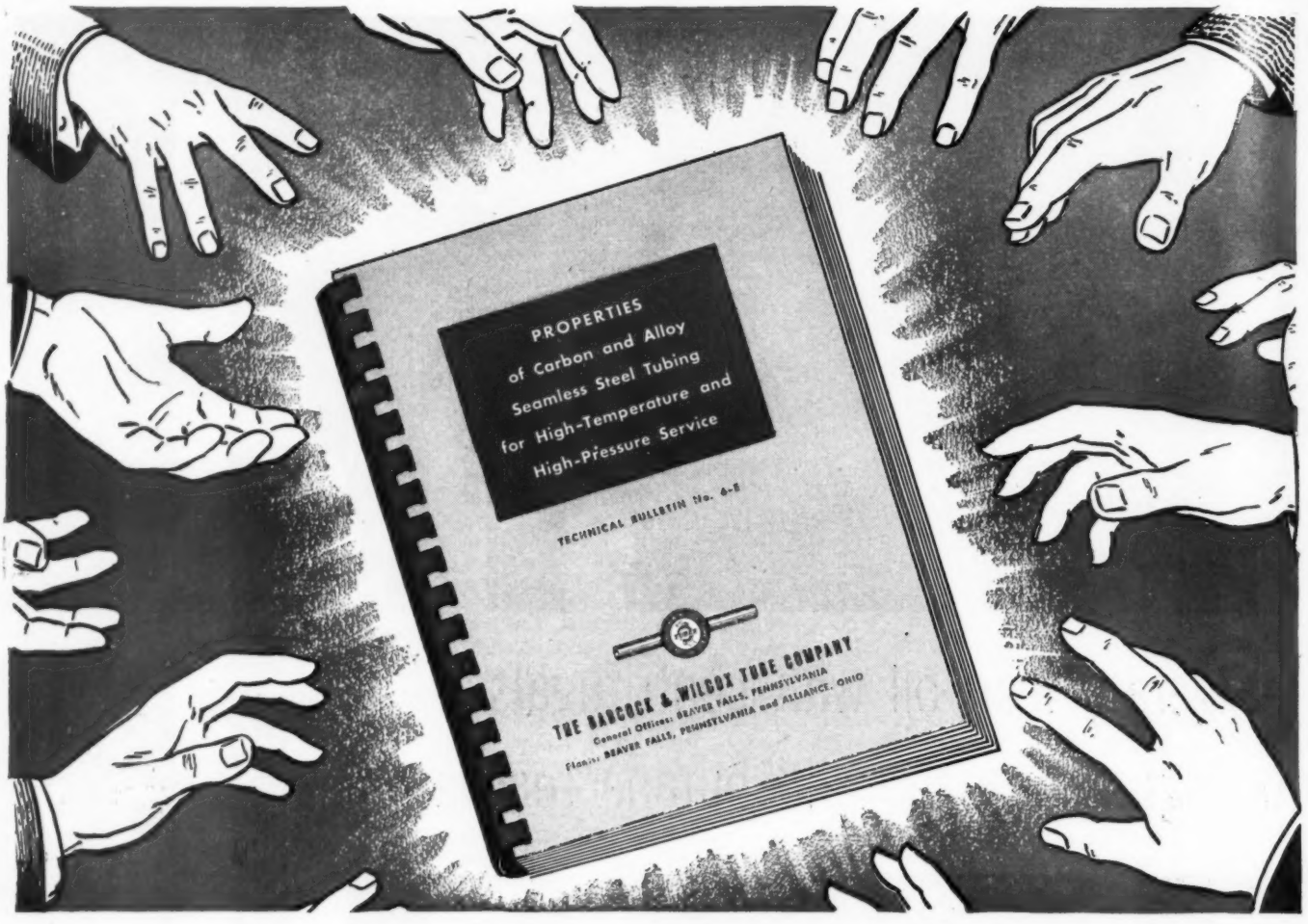

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A Knocktest Laboratory Reports on–

USE OF ISOOCTANE and NORMAL HEPTANE AS REFERENCE FUELS

By HAROLD M. TRIMBLE, L. A. McREYNOLDS, and BILL MITACEK
Phillips Petroleum Co., Research Department

A series of investigations was made on the use of the primary type reference fuels isooctane and normal heptane in making knocktest ratings in laboratory CFR-ASTM test engines. The primary fuels were found to compare favorably with secondary reference fuels in reproducibility, productivity rate, knockmeter reading stability and engine cleanliness.

For the induction systems of ASTM Motor and Aviation and the Research test engine, the use of a 5-in. induction pipe in place of the conventional 2⅝-in. pipe was found to improve engine operating conditions, among other advantages. Committee D-2 has recommended that ASTM knocktest procedures be revised to provide for the use of the larger diameter induction pipe.

AT THE end of the war the attention of various automotive and petroleum company technicians turned to the problem of improving the reference fuels for use in determining antiknock characteristics of fuels in cars. Up to this time it had been considered necessary to use so-called "secondary fuels" because the primary knocktest reference fuels were so expensive. This had resulted in much confusion in evaluation of the road test results obtained because road ratings so determined were just ratings of so much of reference fuel A in reference fuel B.

Discussion of road ratings was difficult because of the different terminology from laboratory ratings and as a result "road octane numbers" were often assigned on the basis of a laboratory engine calibration of the "secondary fuels". These numbers were not true road octane numbers and were different for different "secondary fuels", so confusion often reigned supreme.

In order to assist in alleviating this situation Phillips Petroleum Co. went to work to produce isooctane and n-heptane of sufficient purity at a price considered reasonable for such uses. They were able to produce both products of such purity that they even met the specifications for the primary fuels.

Since primary quality reference fuels isooctane and normal heptane have become available, various programs have been conducted in the Phillips laboratories to determine their functional characteristics in engines. A paper entitled "Normal Heptane as a Reference Fuel for Use in Measuring the Antiknock Quality of Gasoline"(1) covered the use of primary type reference fuels for road test work. This report covers the use of reference fuels isooctane and normal heptane in laboratory CFR-ASTM antiknock test engines.

Investigations

The following investigations were made in the Phillips laboratories relative to the use of isooctane and normal heptane as reference fuels for the CFR-ASTM antiknock engines.

A—Evaluation of Phillips Petroleum Co.'s Pure Isooctane and Normal Heptane as Reference Fuels for Determining Ratings on Motor Fuels.

This investigation was made prior to the adoption of Phillips isooctane and normal heptane for use as reference fuels by the Motor Fuels and Aviation Fuels Divisions of CFR. Our monthly motor fuel survey samples for August and October, 1946, served as test fuels in conducting this program.

It was thought desirable to have a comparison of ratings obtained using Phillips reference fuels isooctane and normal heptane and secondary reference fuels M-4, C-13 and F-6, since there had been indications that primary reference fuels were quite sensitive to engine conditions.

The root-mean-square deviation on 136 motor fuel samples rated using both secondary and primary type reference fuels was 0.27 octane number, which indicates good precision. The root-mean-square deviation is used as a precision measure and is obtained by solving the following equation:

$$\text{Root-Mean-Square Deviation} = \sqrt{\frac{\text{sum of (deviations)}^2}{\text{number of values}}}$$

B—A Comparison of the Reproducibility of Knocktests Using the Primary and Secondary Type Reference Fuels.

In order to compare the reproducibility of knock ratings using primary and secondary type reference fuels, an analysis of data was made of the reproducibility of antiknock ratings obtained by the 8 laboratories in our company exchange group.

In general the exchange program consists in testing two samples circulated every two weeks to the 8 laboratories involved. Only Motor method ratings were obtained with sufficient regularity to permit analysis.

Each set of ratings was averaged and the deviation of each laboratory's rating from this average rating was determined. Average monthly deviations for each laboratory were obtained by averaging each laboratory's deviation for each sample tested during the month. Yearly by months average deviations were obtained by taking a two-year period of average monthly deviations and averaging yearly periods of these averages. Each yearly average obtained is shown in the last month used in each yearly period. The average monthly deviations for the period June, 1945 to March, 1948 inclusive and yearly by months average deviations covering the period May, 1946 to March, 1948 inclusive are given in the tables. Laboratories Nos. 7 and 8 did not start participating until November, 1945.

Table 1 shows the average monthly deviations for our company's exchange samples. It should be noted that Laboratories 1, 2, 3, and 5 had the largest deviation for one month while using secondary reference fuels while Laboratories 4, 6, 7, and 8 had the largest deviation for one month with the new primary type reference fuels. The poor showing for Laboratory 4 for April, 1947, Laboratory 6 for August, 1947, and Laboratory 7 for November, 1947, resulted principally from very high deviations on one pair of samples.

Table 2 shows yearly by months average deviations in octane number on company exchange samples. This analysis was made to see if there was a tendency for the deviations to decrease or increase when the new reference fuels were used. It may be noted that Laboratories 1 and 5 remained essentially the same dur-

TABLE 1—Phillips Petroleum Co.'s Laboratories Average Monthly Deviations on Company Exchange Samples

Month	Motor Octane Number Deviations Lab. 1	Lab. 2	Lab. 3	Lab. 4	Lab. 5	Lab. 6	Lab. 7	Lab. 8	Ave.	No. of Samples
June, 1945	0.30	0.95	0.33	0.35	0.80	0.28	...	...	0.50	4
July	0.17	0.37	0.20	0.18	0.15	0.23	...	...	0.22	4
August	0.23	0.23	0.20	0.23	0.30	0.53	...	...	0.29	6
September	0.18	0.25	0.18	0.25	0.08	0.23	...	...	0.20	4
October	0.23	0.48	0.50	0.33	0.55	0.28	...	...	0.40	4
November	0.18	0.20	0.22	0.25	0.55	0.15	0.08	0.32	0.24	4
December	0.33	0.13	0.30	0.32	0.48	0.50	0.35	0.55	0.37	6
January, 1946	0.12	0.18	0.40	0.12	0.20	0.08	0.38	0.30	0.22	4
February	0.32	0.30	0.42	0.65	0.42	0.85	0.45	0.45	0.48	4
March	0.17	0.43	0.67	0.50	0.67	0.57	0.20	0.30	0.44	2(e)
April	0.38	0.32	0.48	0.30	0.22	0.55	0.55	0.38	0.40	4
May	0.18	0.25	0.22	0.28	0.18	0.82	0.42	0.22	0.32	4
June	0.32	0.35	0.60	0.45	0.35	0.23	0.28	0.35	0.37	4
July	0.18	0.12	0.05	0.18	0.12	0.22	0.20	0.22	0.16	4(b)
August	0.08	0.32	0.45	0.32	0.16	0.30	0.32	0.38	0.29	4(c)
September	0.08	0.42	0.20	0.08	0.32	0.45	0.35	0.25	0.27	4
October	0.47	0.05	0.23	0.20	0.27	0.27	0.20	0.50	0.27	3(c)
November	0.30	0.42	0.44	0.28	0.68	0.32	0.22*	0.28	0.37	4(c)
December	0.28	0.25	0.38	0.45	0.33	0.42	0.52*	0.27	0.36	6
January, 1947	0.12*	0.48	0.25*	0.25(a)	0.25(a)	0.22	0.35*	0.38*	0.29	4
February	0.28*	0.30	0.32*	0.32	0.35*	0.10	0.30*	0.52*	0.31	4
March	0.32*	0.35	0.55*	0.30*	0.48*	0.52*	0.50*	0.62*	0.46	4
April	0.25*	0.58	0.15*	0.95*	0.12*	0.28*	0.40*	0.18*	0.36	4
May	0.18*	0.42*	0.20*	0.30*	0.25*	0.28*	0.50*	0.42*	0.32	4
June	0.20*	0.31*	0.45*	0.38*	0.68*	0.31*	0.50*	0.33*	0.40	6
July	0.28*	0.32*	0.28*	0.32*	0.12*	0.32*	0.42*	0.42*	0.31	4
August	0.22*	0.58*	0.28*	0.52*	0.45*	0.90*	0.38*	0.63*	0.50	4
September	0.15*	0.18*	0.20*	0.20*	0.12*	0.55*	0.30*	0.50*	0.28	4
October	0.25*	0.18*	0.10*	0.08*	0.18*	0.15*	0.15*	0.32*	0.18	4
November	0.20*	0.70*	0.32*	0.18*	0.40*	0.52*	0.60*	0.20*	0.39	4
December	0.15*	0.32*	0.38*	0.27*	0.42*	0.57*	0.23*	0.40*	0.34	6
January, 1948	0.22*	0.42*	0.45*	0.42*	0.40*	0.78*	0.22*	0.60*	0.44	4
February	0.20*	0.30*	0.22*	0.52*	0.18*	0.32*	0.30*	0.60*(f)	0.33	4
March	0.05*	0.35*	0.50*	0.12*	0.25*	0.22*	0.32*	0.55*	0.29	4

* Samples rated using the primary type reference fuels

(a) Secondary fuels used for rating two samples and primary type fuels used for rating two samples.

(b) Six samples were distributed, two of which were very low-octane number. The spread of ratings on these low octane number samples was exceedingly high and so adversely affected the deviations for this month that the data on them were omitted from this analysis.

(c) Five ratings were analyzed this month since one sample was tested clear and leaded.

(d) Four samples were tested, however, only a TEL requirement was determined on one of the samples.

(e) Three ratings were analyzed this month since one sample was tested clear and leaded.

(f) Only two samples tested this month.

ing the two periods. Laboratories 3 and 6 showed a small but definite improvement while Laboratories 4, 7, and 8 showed a slight loss. Laboratory 2 showed a definite loss.

The average of the yearly by months average deviations as shown in Table 2 indicates that the precision of testing was practically unchanged during the two periods. An inspection of this table shows that for about two months after the use of the benzene and X-5 standardization fuels were begun, the average values were slightly higher. However, the average values dropped to approximately normal the following month. This seems to indicate that each time a standardization fuel is changed, a certain period of time is needed for the laboratories to adjust themselves to the new fuel.

C—A Comparison of the Productivity of Knocktests Using Primary and Secondary Type Reference Fuels.

The study of productivity of knocktests was made from the time and test records of the various knocktest operators in the Research Department at Bartlesville.

The number of Motor and Research knocktests was divided by the number of hours worked to obtain the index of productivity. This included maintenance time. This was done by months for the period January, 1946, to March, 1948, inclusive.

Table 3 shows a comparison of the productivity of knocktests obtained using both types of reference fuels. An average productivity of 0.94 knocktests per hour was obtained during the period January, 1946, to December, 1946, inclusive when secondary reference fuels were being used for knocktesting in our laboratory. An average productivity of 0.87 knocktests per hour was obtained for the period February, 1947, to March, 1948, inclusive when the new primary type reference fuels were used. Because both types of fuels were used in January, this month was not included in either of these overall averages. This analysis covered 29,814 knocktests.

It may be noted that the productivity dropped during the summer months for both cases. No fully satisfactory explanation has been found for this, however, it has been observed each summer and the hot weather is undoubtedly at least a contributing factor.

The next item investigated was a comparison of the average tests per rating using the two reference fuel systems. This analysis was limited to data obtained on samples rated in the laboratory of the Research Department. In striving for as high a degree of precision as possible, a decision is sometimes made to rerate a sample. If the agreement between these tests is not good a third test may be made. Also previous experience may indicate some question of a single test obtained on a given product. In such a case an additional test would be run before assigning a rating. Thus more than one test may be required to establish a rating for a given sample. An analysis was made of the data on a representative group of samples. Table 4 presents the information obtained:

The period from January, 1946, to December, 1946, inclusive when secondary reference fuels were used had a value of 1.48 tests per rating. The period from February, 1947 to June, 1947 inclusive when the primary type reference fuels and X-4 standardization fuel were used had a value of 1.35 tests per rating. January, 1947 was not included in this analysis since both types of reference fuels were used during this month.

The period from July, 1947, to November, 1947, inclusive was investigated next. This is the period in which the new benzene standardization fuels have been in use in our laboratory. The value of 1.40 tests per rating is notably higher than for the other periods when the primary

TABLE 2—Phillips Petroleum Co.'s Laboratories Yearly by Months Average Deviations on Company Exchange Samples

	Motor Octane Number Deviations									
Month	Lab. 1	Lab. 2	Lab. 3	Lab. 4	Lab. 5	Lab. 6	Lab. 7	Lab. 8	Ave.	No. of Samples
May, 1946	0.23	0.34	0.34	0.31	0.38	0.42	0.35	0.36	0.34	4
June	0.23	0.29	0.37	0.32	0.35	0.42	0.34	0.36	0.34	4
July	0.24	0.27	0.35	0.32	0.34	0.41	0.32	0.34	0.32	4(b)
August	0.22	0.28	0.37	0.33	0.33	0.40	0.32	0.35	0.32	4(c)
September	0.21	0.29	0.38	0.32	0.35	0.41	0.33	0.34	0.33	4
October	0.23	0.26	0.35	0.30	0.33	0.41	0.32	0.35	0.32	3(d)
November	0.24	0.27	0.37	0.31	0.34	0.43	0.33*	0.35	0.33	4(c)
December	0.24	0.28	0.38	0.32	0.33	0.42	0.34*	0.32	0.33	6
January, 1947	0.24*	0.31	0.37*	0.33(a)	0.33(a)	0.44	0.34*	0.33*	0.34	4
February	0.24*	0.31	0.36*	0.30	0.32*	0.37	0.33*	0.34*	0.32	4
March	0.25*	0.30	0.35*	0.28*	0.31*	0.37*	0.35*	0.36*	0.32	4
April	0.24*	0.32	0.32*	0.34*	0.30*	0.35*	0.34*	0.35*	0.32	4
May	0.24*	0.34*	0.32*	0.34*	0.31*	0.31*	0.36*	0.36*	0.32	4
June	0.23*	0.34*	0.31*	0.33*	0.33*	0.31*	0.36*	0.36*	0.32	6
July	(1)0.24*	0.35*	0.32*	0.35*	(2)0.33*	0.32*	(1)0.38*	(2)0.38*	0.33	4
August	(1)0.25*	0.37*	(1)0.31*	0.36*	(1)0.36*	0.37*	(1)0.39*	(1)0.40*	0.35	4
September	(1)0.25*	0.35*	(1)0.31*	0.37*	(1)0.34*	0.37*	(1)0.38*	(1)0.42*	0.35	4
October	(1)0.24*	0.36*	(1)0.30*	0.36*	(1)0.33*	0.36*	(1)0.38*	(1)0.41*	0.34	4
November	(1)0.23*	0.39*	(1)0.29*	0.35*	(1)0.31*	(1)0.38*	(1)0.41*	(1)0.40*	0.34	4
December	(3)0.22*	0.39*	(1)0.29*	0.34*	(3)0.32*	(3)0.39*	(1)0.39*	(3)0.41*	0.34	6
January, 1948	(3)0.22*	0.39*	(3)0.31*	(4)0.35*	(3)0.33*	(3)0.44*	(3)0.38*	(3)0.43*	0.36	4
February	(3)0.22*	0.39*	(3)0.30*	(3)0.37*	(3)0.32*	(3)0.46*	(3)0.38*	(3)0.44*	0.36	4
March	(3)0.20*	0.39*	(3)0.29*	(3)0.36*	(3)0.30*	(3)0.39*	(3)0.31*	(3)0.41*	0.33	4

* Indicates months during which ratings were obtained using primary type reference fuels.
(1) Indicates months in which new benzene standardization fuels were used.
(2) New benzene standardization fuels used beginning July 15, 1947.
(3) Indicates months in which X-5 standardization fuels were used.
(4) X-5 standardization fuels used beginning Jan. 15, 1948.
(a) Secondary fuels used for rating two samples and primary type fuels used for rating two samples.
(b) Six samples were distributed, two of which were very low octane number. The spread of ratings on these two low-octane number samples were exceedingly high and so adversely affected the deviations for this month that the data on them were omitted from this analysis.
(c) Five ratings were analyzed this month since one sample was rated clear and leaded.
(d) Four samples were tested, however, only a TEL requirement was determined on one of the samples.

type reference fuels were used. The period from December, 1947 to March, 1948 inclusive, when X-5 standardization fuel was used, had a value of 1.32 tests per rating. The average for the entire period in which the primary type reference fuels were used is 1.36 tests per rating.

Another measure of the productivity may be obtained by dividing the average productivity, expressed in knocktests per hour, by the tests per rating values to obtain sample ratings per hour. This method of expressing productivity is the one of most interest since it is a true measure of the productivity of a laboratory. The ratings per hour value for secondary reference fuels is $\frac{0.94}{1.48} = 0.635$, while for the primary type reference fuels it is $\frac{0.87}{1.36} = 0.640$.

D—Stability Tests on Secondary and Primary Type Reference Fuels.

This investigation covered stability tests on secondary and primary type reference fuels. The stability test is ordinarily used as a measure of the performance of a bouncing pin. However, in this case the stability tests were run on both types of fuels the same day and should be an index of the knockmeter stability for the reference fuel being used. The following series of reference fuel blends were tested: (1) 59, 60, and 61-octane number blends of both types of reference fuel; (2) 79, 80, and 81-octane number blends of both types of reference fuel. In addition, a leaded motor fuel with two bracketing reference fuels of each type was tested.

TABLE 3—Comparison of the Productivity of Motor and Research Ratings(3) Obtained Using Both Types of Reference Fuels

Month	Time Spent (Hours)	ASTM (Motor) and Research Knock-tests	Productivity (Knock-tests Per Hour)
	Secondary Ref. Fuels(1)		
January, 1946	1321.0	1273	0.96
February	1401.0	1550	1.11
March	1586.0	1646	1.04
April	1504.0	1456	0.97
May	1659.5	1330	0.80
June	1073.0	895	0.83
July	1429.0	1072	0.75
August	778.7	714	0.92
September	648.0	681	1.05
October	863.0	845	0.98
November	706.2	713	1.01
December	834.2	766	0.92
	Primary Type Ref. Fuels(2)		
January, 1947*	998.5	942	0.94
February	670.5	708	1.06
March	930.0	898	0.97
April	1072.0	1059	0.99
May	1109.0	992	0.89
June	1222.0	1023	0.84
July	1581.8	1347	0.85
August	1377.0	965	0.70
September	1174.0	1008	0.86
October	1695.0	1508	0.89
November	1253.0	1154	0.92
December	1554.5	1280	0.82
January, 1948	1541.7	1387	0.90
February	1534.0	1374	0.90
March	1533.0	1228	0.80

Ref. Fuel Type	Totals Hours	Totals Tests	Average Productivity Knock-tests/Hr.
Secondary	13,803.6	12,941	0.94
Primary	18,247.5	15,931	0.87

(1) F-6, C-13 and M-4.
(2) Phillips Isooctane and Normal Heptane.
(3) Ratings obtained in Phillips Research Laboratory, Bartlesville, Okla.
* Primary type reference fuels used beginning Jan. 16, 1947.

Table 5 shows a typical example of a stability test. Three successive readings are taken on each fuel at 10-second intervals and one interval of 2 minutes is allowed each time the fuel is changed. Ten sets of readings are taken in this manner. The average knockmeter readings are calculated and the stability figure obtained by averaging the deviations of the 10 readings from the average value. This procedure is followed for each of the 9 horizontal lines of data. The average stability figure is obtained by averaging the 9 stability values.

Table 6 shows average stability data for the different sets of fuels used in this investigation. Data were obtained using a bouncing pin and an experimental model of Phillips detonation meter, Model 501. A description of the 501 model meter is covered in a paper entitled "An Electronic Detonation Meter for Motor-Fuel Antiknock Rating"(2). Of the 6 sets of stability data, 2 are the same and 4 show better stability with the primary type reference fuels.

E—Tests to Determine the Comparative Engine Cleanliness When Using Primary Type Reference Fuels and Secondary Reference Fuels.

Since there were a few reports that the new type fuels gave a

TABLE 4—Comparison of Average Tests per Rating Using the Two Reference Fuel Systems

Period	Reference Fuels	Standardization Fuels	Number Tests	Number Ratings	Tests Rating
Jan., 1946 to Dec., 1946 Incl...	Secondary	X-4	5856	3958	1.48
Feb., 1947 to June, 1947 Incl...	Primary	X-4	2512	1863	1.35
July, 1947 to Nov., 1947 Incl...	Primary	Benzene	2931	2087	1.40
Dec., 1947 to March, 1948 Incl.	Primary	X-5	1870	1417	1.32
Average for Primary Type Fuels			7313	5367	1.36

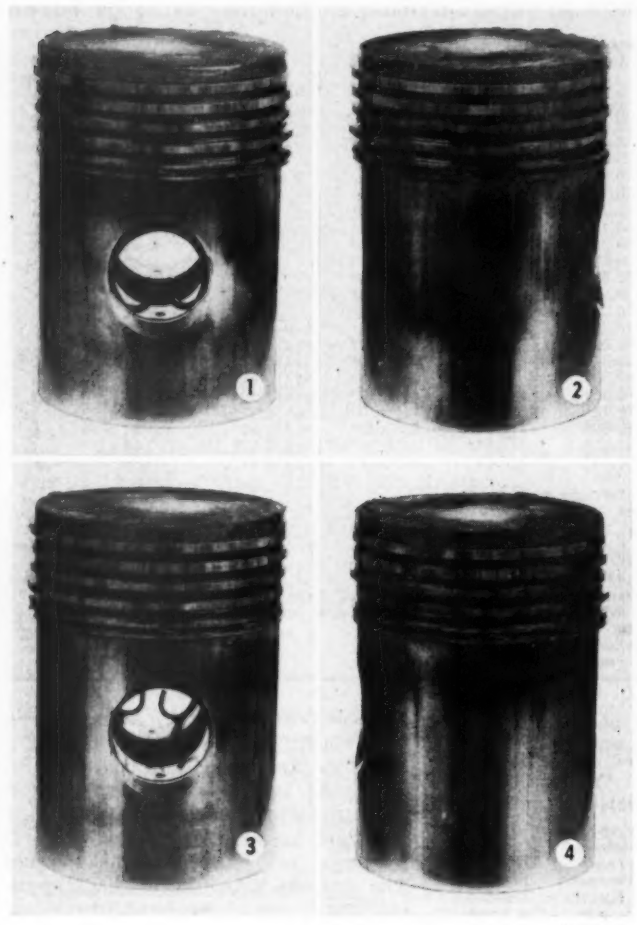

Fig. 1—Four views of a cast iron piston which was run 150 hours on a Motor engine using 80% isooctane and normal heptane

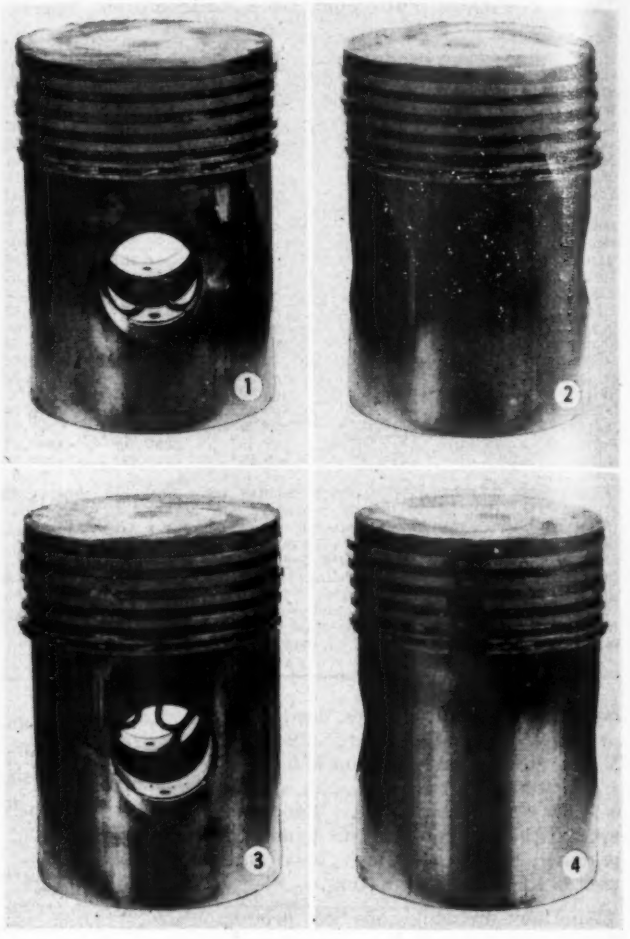

Fig. 2—Four views of a cast iron piston which was run 150 hours on a Motor engine using an 80-octane number blend of F-16 and C-13

dirtier piston and valves, it was decided to run a 150-hour test on a Motor engine using both types of reference fuels to check on this point. The first test was run using a blend of 80-octane number isooctane and normal heptane. The piston used in this test was rated 6.0 on the Lauson rating scale for which a rating of 10 is assigned a perfectly clean piston. The next test was run using an 80-octane number blend of F-6 and C-13. The piston used in this test was rated 5.0. An additive SAE 30 oil was used in the engine for both tests and was changed every 50 hours. In both tests the heater housing remained very clean of deposits. There was a noticeable deposit on the intake valve for both tests.

Fig. 1 shows photographs of 4 positions of the piston which was used when testing the 80-octane number blend of isooctane and normal heptane and Fig. 2 shows photographs of corresponding positions of the piston used when testing the 80-octane number blend of F-6 and C-13. It may be noted that there is very little difference in the appearance of the two pistons.

With the change to the primary quality reference fuels, isooctane and normal heptane, we discovered that those carburetors in which the new type reference fuels were placed in most cases required a different size jet than most test fuels and the old type reference fuels. Of course, this is not too great a hardship provided the reference fuel blends are always placed in the same carburetor, but it was also found that, whenever the test fuels covered a wide octane number range, sometimes one reference fuel blend required a jet size different from that required by another reference fuel blend.

In this connection it had been previously noted that with the advent of the use of the ice tower on the various knocktest methods, there had been indications that the induction system was quite sensitive to variations in the type of fuel being tested. In addition, it had been reported by various laboratories that the installation of ice towers slowed down the speed of testing. This seemed to arise from the indications that it took longer for the knockmeter reading to stabilize. Some investigations of these effects had been carried out in various laboratories through CFR test programs. One thing noted in our laboratory early in this work was that the carburetor jets would have to be changed in order to stay within the required carburetor level range when changing from no ice tower to standard ice tower.

This, of course, suggested the possibility that the ice tower and its induction system were influencing the operational characteristics of the engine and as a result might be having an effect on ratings. However, neither our work nor any of the CFR work had indicated any effect on ratings provided, of course, there was no appreciable change in humidity of the air going into the engine. So the concern over this effect disappeared and operators have usually just changed the jets as required depending on whether or not they were using the ice tower and proceeded with testing.

One thing learned during the work, however, was that the installation of a larger induction pipe seemed to eliminate all of these difficulties, i.e., sensitivity of various fuels to carburetor level was decreased, it was not necessary to

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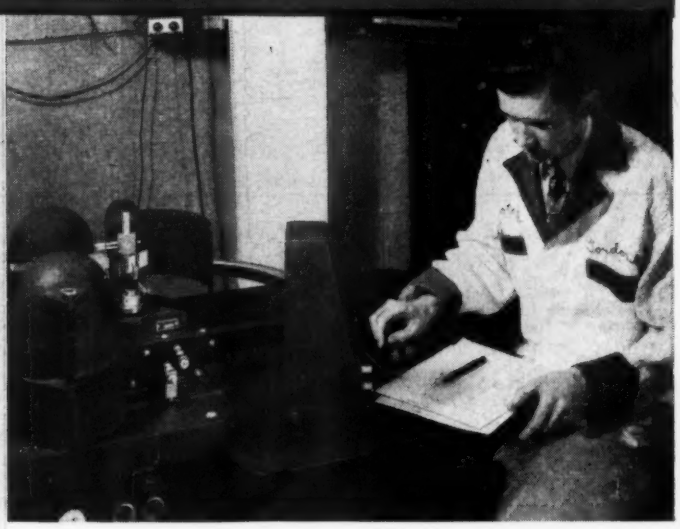

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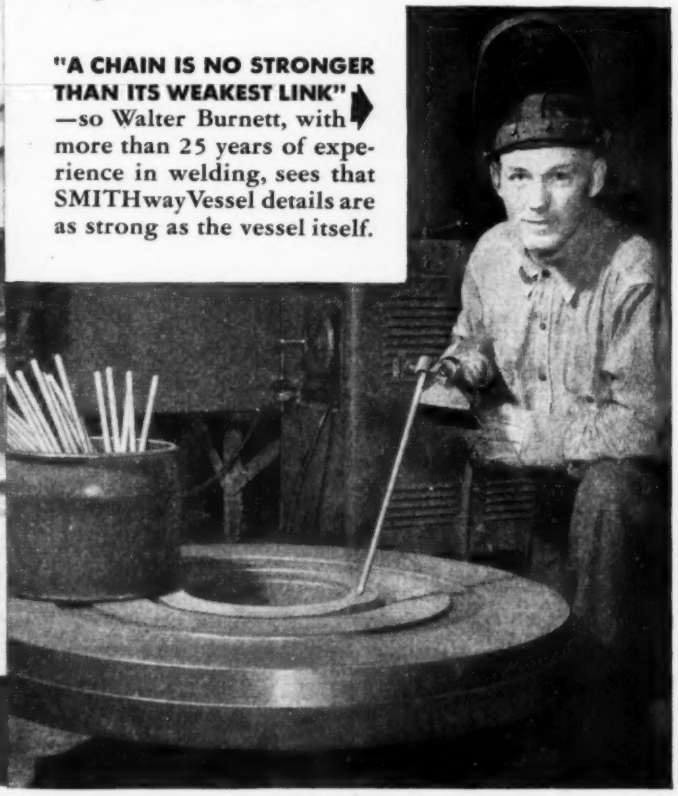

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TABLE 5—Typical Stability Test[1] Data

Octane No. of Reference Fuel Blend	Knockmeter Reading — Run No. 1	2	3	4	5	6	7	8	9	10	Avg.	Stability
	65	67	68	66	64	63	63	65	63	66	65.0	1.4
74	64	65	67	65	63	64	63	65	65	65	64.6	.9
	64	66	66	67	62	64	65	64	65	64	64.7	1.1
	55	53	55	53	52	53	54	54	53	52	53.4	.9
75	54	52	54	54	54	53	55	53	52	53	53.4	.8
	55	55	56	54	54	54	56	52	51	54	54.1	1.1
	50	50	48	50	52	50	48	50	48	49	49.5	1.0
76	49	52	50	52	50	50	49	51	48	50	50.1	.9
	50	50	49	51	49	49	50	52	47	51	49.8	1.0
												1.0*

(1) The stability test procedure is given on page 76 of the 1946 CRC Handbook.
* Average.

TABLE 6—Average Stability Data on Secondary and Primary Type Reference Fuels Obtained by the Motor Method

2⅝-in. Induction Pipe — Bouncing Pin Stability	Bouncing Pin Date Run	Meter[1] Stability	Meter[1] Date Run	Fuels Used
1.0	5-29-47	0.5	6-5-47	59, 60, 61 Oct. No. blends of isooctane and normal heptane
1.4	5-29-47	0.9	6-5-47	59, 60, 61 Oct. No. blends of C-13 and M-4
0.8	6-4-47	1.5	6-3-47	79, 80, 81 Oct. No. blends of isooctane and normal heptane
1.8	6-4-47	1.7	6-3-47	79, 80, 81 Oct. No. blends of F-6 and C-13
1.6	6-4-47	1.8	5-21-47	73.8% iC_8/nC_7 Leaded Motor Fuel
				75.8% iC_8/nC_7
1.6	6-4-47	1.8	5-21-47	11% F-6/C-13 (73.8 Oct. No.) Leaded Motor Fuel
				19% F-6/C-13 (75.8 Oct. No.)

(1) Experimental model of Phillips detonation meter.

change jets when changing from no ice tower to ice tower, and time of testing was speeded up.

In view of this, it appeared that possibly the present difficulties might all be the result of the sensitivity of the induction system to variations in fuels and operating conditions. In addition to this, we were still quite concerned about the increased time required for running a test, so it was thought desirable at this time to determine if different types of reference fuels could be used with no changes in jet sizes when using a larger induction type.

The following induction systems were investigated on the ASTM (Motor) engine:

1. 5-in. induction pipe with no surge tank and used with standard ice tower (125° F. inlet air temperature).
2. No ice tower and intake temperature of 83° F. No inlet air heater was used.
3. 2⅝-in. induction pipe with standard surge and ice tower (125° F. inlet air temperature).
4. No ice tower used. Inlet air heater used to maintain 125° F. temperature.
5. 5-in. induction pipe with standard surge tank and ice tower (125° F. inlet air temperature).

The test fuels were 70% X-4/M-4 and 100% X-4. These fuels were bracketed using the old and new type reference fuels.

The following induction systems were investigated on the Research engine:

1. 2⅝-in. induction pipe with surge tank and ice tower.
2. 5-in. induction pipe with surge tank and ice tower.
3. No ice tower used. Air heater used to maintain inlet air temperature of 125° F.
4. 5-in. induction pipe with no surge tank and used with standard ice tower.

The test fuels were 60% X-4/M-4 and 90% X-4/M-4. For Part 1 and 2, 60% X-4/M-4 was rated using both types of reference fuel. The 90% X-4/M-4 blend was rated using isooctane and normal heptane. For Parts 3 and 4, the 60% X-4/M-4 blend was rated using isooctane and normal heptane.

The following induction systems were investigated on the ASTM Aviation engine:

1. 5-in. induction pipe with no surge tank and used with standard ice tower.
2. No ice tower used. Air heater used to maintain inlet air temperature of 125° F.
3. 2⅝-in. induction pipe with surge tank and used with standard ice tower.
4. No ice tower used. Inlet air temperature 80° F. No inlet air heater used.
5. 5-in. induction pipe with surge tank and standard ice tower. Inlet air temperature 80° F.
6. 5-in. induction pipe with surge tank and standard ice tower. Inlet air temperature 125° F.

The test fuel was a 90-octane number benzene standard using F-6 and M-4. This fuel was rated using both types of reference fuels.

The different blends of isooctane and normal heptane used as reference fuels were obtained by blending RAMFD-HO-46 (60-40 blend of iso-

TABLE 7—ASTM (Motor) Antiknock Data on Different Induction Systems

Part A—2⅝-in. Induction Pipe with Standard Surge Tank and Ice Tower[1]

Carb. Bowl No.	Fuel	Float Level	Knock Meter Reading	Carb. Jet Drill Size	Rating Octane Number	Micrometer Setting	Barometer (Inches Hg.)
2	7% F-6/C-13	1.85[2]	65	67			
3	70% X-4/M-4	1.35	54	68	74.4	0.465	29.15
1	14% F-6/C-13	1.55	53	68			
2	72% iC_8/nC_7	1.20	64	67			
3	70% X-4/M-4	1.35	50	68	73.9	0.465	29.15
1	74% iC_8/nC_7	1.15	49	67			
2	78% F-6/C-13	1.05	63	68			
3	100% X-4	1.35	55	68	91.4	0.226	28.99
1	83% F-6/C-13	1.65	47	68			
2	90% iC_8/nC_7	1.80[3]	69	67			
3	100% X-4	1.45	54	68	91.5	0.226	28.99
1	92% iC_8/nC_7	1.40	49	68			

Part B—5-in. Induction Pipe with Surge Tank and Standard Ice Tower[1]

Carb. Bowl No.	Fuel	Float Level	Knock Meter Reading	Carb. Jet Drill Size	Rating Octane Number	Micrometer Setting	Barometer (Inches Hg.)
2	76% iC_8/nC_7	1.40	36	68			
3	70% X-4/M-4	1.65	56	68	74.0	0.472	29.37
1	74% iC_8/nC_7	1.15	56	68			
2	14% F-6/C-13	1.80	53	68			
3	70% X-4/M-4	1.60	57	68	74.2	0.472	29.37
1	7% F-6/C-13	1.60	70	68			
2	78% F-6/C-13	1.80	66	68			
3	100% X-4	1.70	56	68	91.6	0.241	29.37
1	83% F-6/C-13	1.65	49	68			
2	90% iC_8/nC_7	1.70	73	68			
3	100% X-4	1.70	54	68	91.6	0.241	29.37
1	92% iC_8/nC_7	1.50	50	68			

(1) Inlet Air Temperature 125 F.
(2) Jet Drill Size of 68 resulted in a level of 0.6.
(3) Jet Drill Size of 68 resulted in a level of 0.7

octane and normal heptane) and Phillips isooctane Lot 126.

Part A of Table 7 shows data obtained by the Motor method using the 2⅝-in. induction pipe with surge tank. It may be noted that jets have to be changed with changes in the types of reference fuel and when rating high octane number fuels. This system is very critical as far as jet sizes are concerned. Part B of Table 7 shows data obtained using a 5-in. induction pipe with surge tank. A carburetor jet drill size of 68 was used for all tests and the operation of the engine was very satisfactory. The following induction systems permitted the use of one jet drill size (68) for making Motor ratings using either type of reference fuel:

1. 5-in. induction pipe with no surge tank.
2. 5-in. induction pipe with surge tank.
3. No ice tower and no air heater used.

The jet drill size for the test fuels (X-4/M-4) was 68 for all of the various systems tried on the Motor engine.

The data obtained by the Research method indicated that a jet drill size of 66 will work satisfactorily on any of the induction systems tried using both types of reference fuels. This test method is not as critical as the ASTM (Motor) method regarding jet sizes. The 5-in. induction pipe with surge tank performed very satisfactorily.

Data obtained using the various induction systems on the Aviation engine indicated that jet sizes have to be changed with the various systems, however, the one jet size for each system may be used with different types of reference fuel. The system using no ice tower and a heater to maintain an inlet air temperature of 125° F., was the poorest system tried with respect to operation of the engine. The system using a 5-in. induction pipe with surge tank worked very satisfactorily. A drawing covering the 5-in. induction pipe for use with the ice tower is attached as Fig. 3.

In view of this experience this information was presented to ASTM at its March, 1947, meeting and Sect. A IV recommended to ASTM Committee D-2 that the ASTM knocktest procedures be revised to provide only a minimum limit of 2⅝-in. for the diameter of the induction pipe thereby allowing anyone wishing to get out of difficulty to put on a 5-in. induction pipe. At its March meeting ASTM Committee D-2 approved this recommendation.

CONCLUSIONS

The following conclusions are made from the data presented:

1. The productivity of knocktests in our laboratory, expressed in sam-

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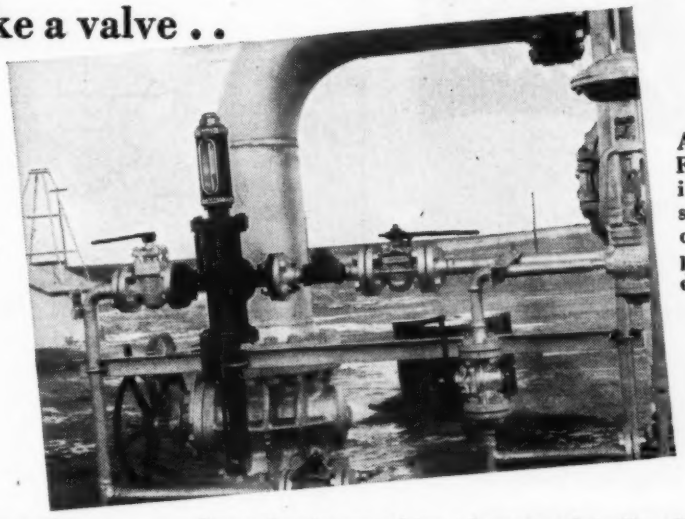

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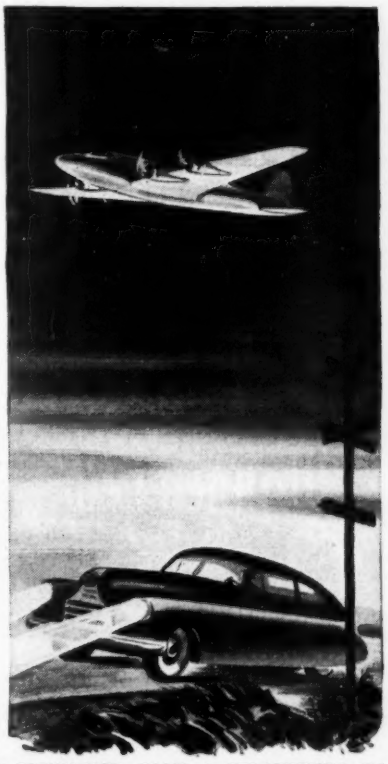

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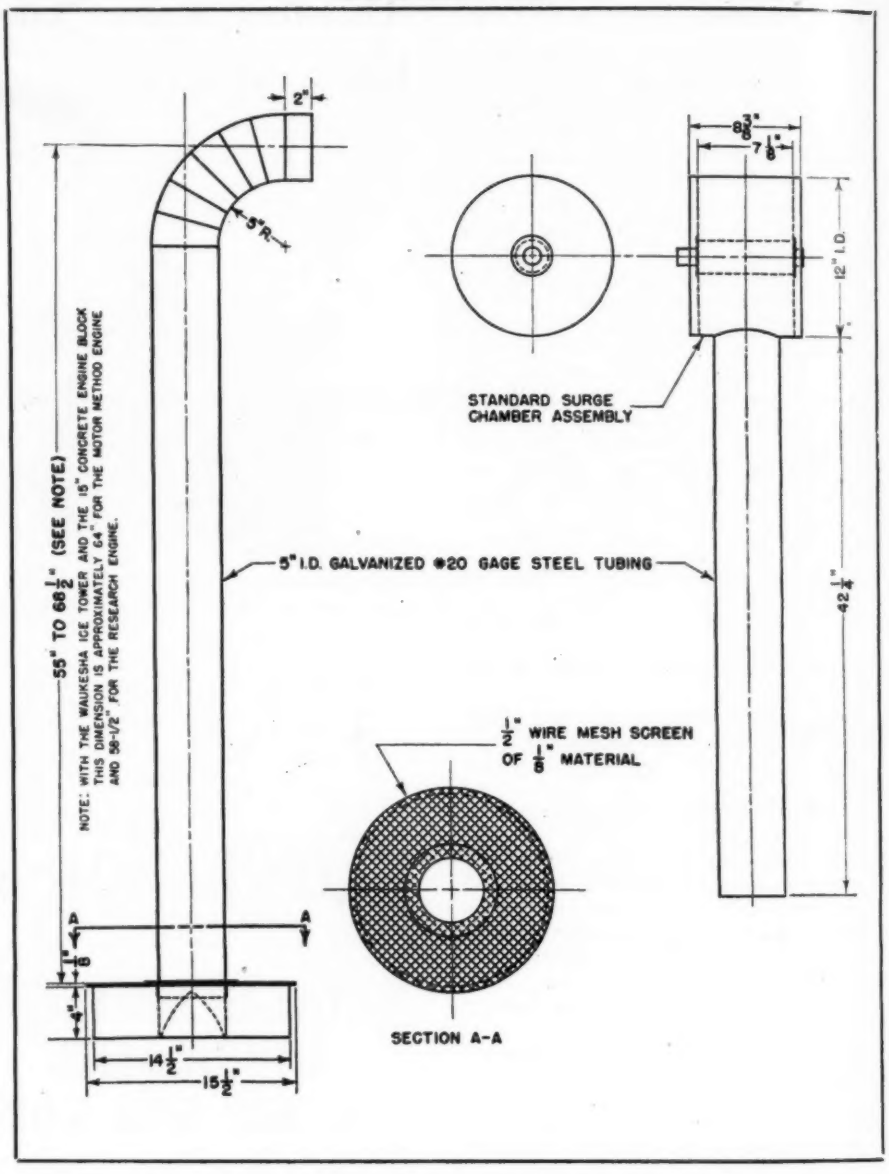


Fig. 3—Details of 5-in. induction pipe for use with ice tower

ple ratings per hour, is slightly greater for the period when the primary type reference fuels were used.

2. The precision of ratings obtained by our company laboratories on common samples has remained fairly constant for the periods when primary type reference fuels were used and when secondary reference fuels were used.

3. 150 hour tests (Motor Method conditions) indicate the piston cleanliness is slightly in favor of the primary fuels.

4. A root-mean square deviation of 0.27 octane number was obtained on 136 motor fuel samples on the basis of the differences between the ratings obtained on these fuels using secondary reference fuels M-4, C-13 and F-6 and the primary type fuels. This indicates no significant change in ratings occurred.

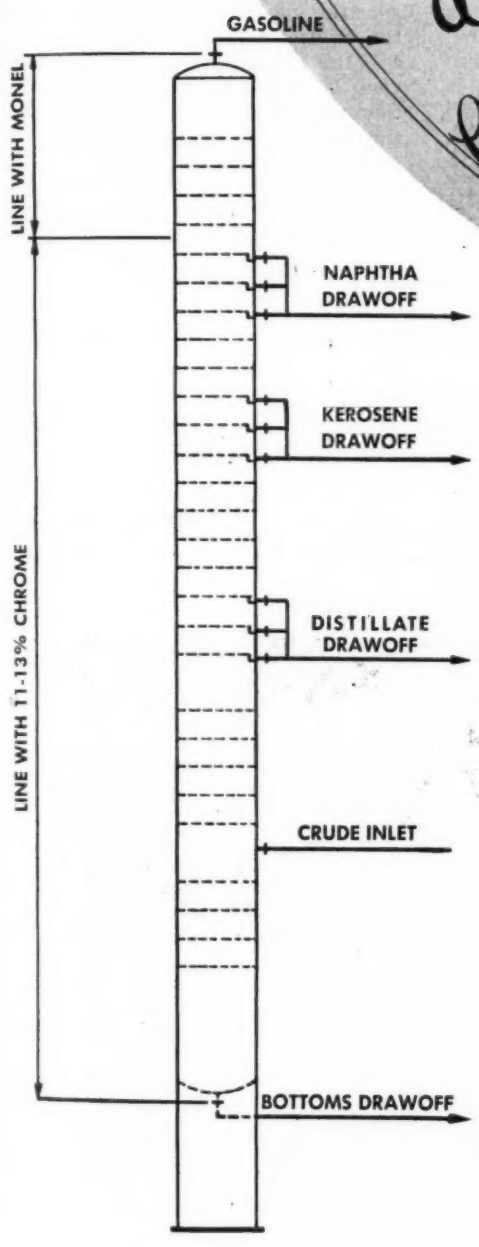
5. Knockmeter stability tests indicated greater knockmeter reading stability with the primary type reference fuels than with the secondary fuels.

6. With a 2⅝-in. induction pipe in the ice tower induction system it is necessary to change the carburetor jets when testing with primary reference fuels over a wide range of octane numbers. The ASTM Motor method is more critical in this respect than either the Research or ASTM Aviation methods. However, both primary and secondary type reference fuels may be used in any of these three methods without changing jets when using a 5-in. induction pipe in the ice tower system. In addition the operation of the engine is much improved with a 5-in. induction pipe as compared to a 2⅝-in. induction pipe.

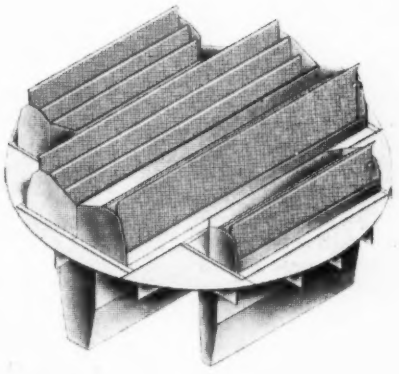
References

(1) *Oil and Gas Journal*, Nov. 2, 1946.
(2) *Oil and Gas Journal*, Nov. 9, 1946.

Rx Our prescription for a trouble-free Crude Fractionating Tower



1. **Koch Kaskade Fractionating and Stripping Trays used throughout.**
2. **Koch trays and shell lining of Monel in the upper section of the tower, where acidic water is apt to condense.**
3. **Koch trays and shell lining of 11-13% chrome in the remainder of the tower to withstand corrosion from sulfur compounds and organic acids.**
4. **Benefits—Freedom from maintenance worries, smoother operation under any loading conditions, better control of product specifications, greater overload capacity. All these benefits at 20-25% decrease in total installation cost, compared to a bubble tray installation.**



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Design and Construction of

PRESSURE RELIEVING SYSTEMS

By NELS E. SYLVANDER and D. L. KATZ

This article is the second dealing with the principles and methods of providing presure relief for refinery equipment. In the first one (PETROLEUM PROCESSING, July, 1948, pg. 642), the authors discussed the causes of excessive pressure in refinery vessels and compared various methods for determining what relief capacity should be provided.

This month they cover the recomended procedure for computing the theoretical relief area needed for a given capacity, the various types of relief devices which can be used, and their proper location and mounting.

Both articles are based on an API research project carried on at the University of Michigan, and have been written for *PETROLEUM PROCESSING* by the two men who conducted the study and prepared the complete report on the project.[1]

THIS section presents recommended procedures for computing the *theoretical relief area* needed for a given capacity. The relationship between the theortical relief area and the dimensions of the relief device is given by a coefficient of discharge. Sect. 6 of the bulletin[1] indicates the coefficients pertaining to each type of device.

Relationship Between Theoretical Area and Size of Relief Device: Calculation of the velocity of a fluid by assuming that compression energy is diverted into velocity energy under adiabatic and reversible conditions permits a calculation of the theoretical area of the nozzle or orifice through which the fluid is flowing. The actual orifice area of a relief device is a minimum cross-sectional area which restricts the flow. If expansion of the fluid through the device is adiabatic and reversible and the flowing fluid has its maximum flow rate at the area of minimum cross-section, the theoretical area computed will coincide with the actual orifice area of the device. Coefficients of discharge are used to correct a theoretical area to the actual orifice area needed for a given relief device.

Equation 5 below has been derived in the Appendix of the bulletin[1] by assuming adiabatic and reversible flow and that the fluid follows the ideal gas law.

$$W = 315\ apC\ (M/T)^{1/2} \quad \ldots\ldots 5$$

in which

a = theoretical area, sq. in., for $C = 1.0$

a = actual area, sq. in., for other values of C

W = capacity, lbs. of vapor per hr.

p = absolute pressure of the vapor at inlet conditions, psia

C = coefficient of discharge

M = molecular weight of vapor discharge

T = absolute temperature of vapor at inlet conditions, °Rankine

This formula, when corrected by the orifice coefficient of discharge for a specific valve or relief device, gives the relationship between the capacity and the actual orifice area of the device. It has been found that the orifice coefficient for well-designed nozzle-type valves is 0.97, based on experiments employing steam. The inclusion of 0.97 as the orifice coefficient (C) in Equation 5 gives the following:

$$W = 306\ ap\ (M/T)^{1/2} \quad \ldots\ldots 6$$

where

a = actual minimum nozzle throat area.

This equation is the *API-ASME Code* formula in which they describe the area (a) as "effective area."

It is recognized that hydrocarbon vapors do not behave as ideal gases

This Month's Cover Picture

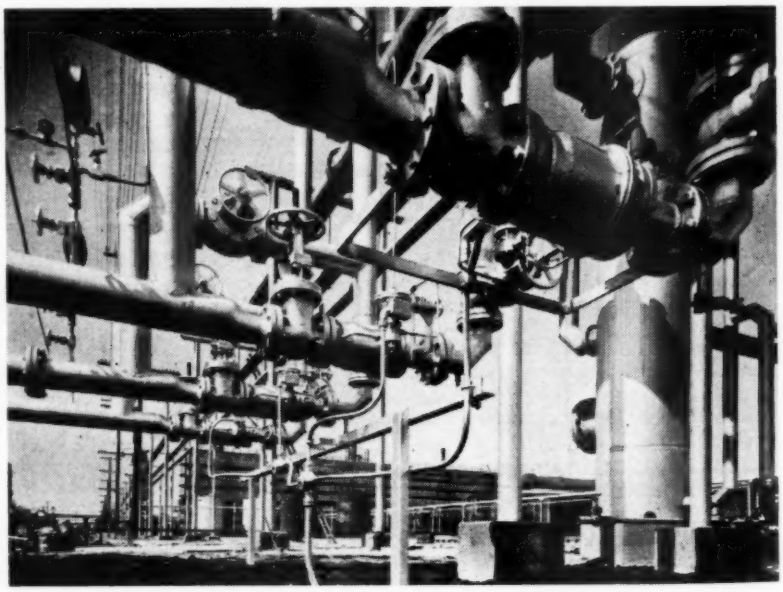
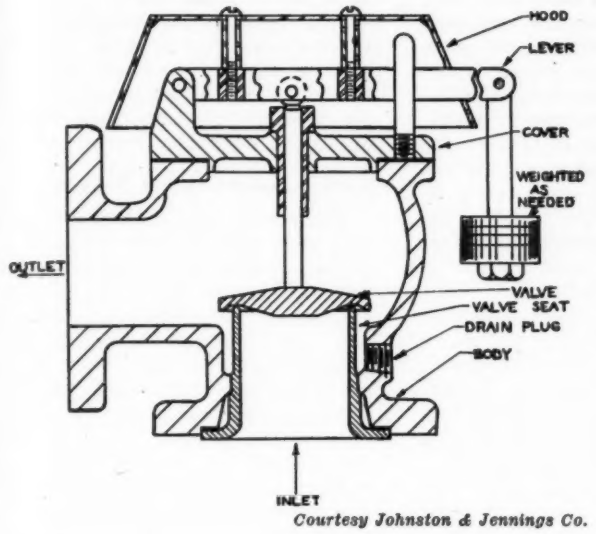


Photo Courtesy General Petroleum Corp.

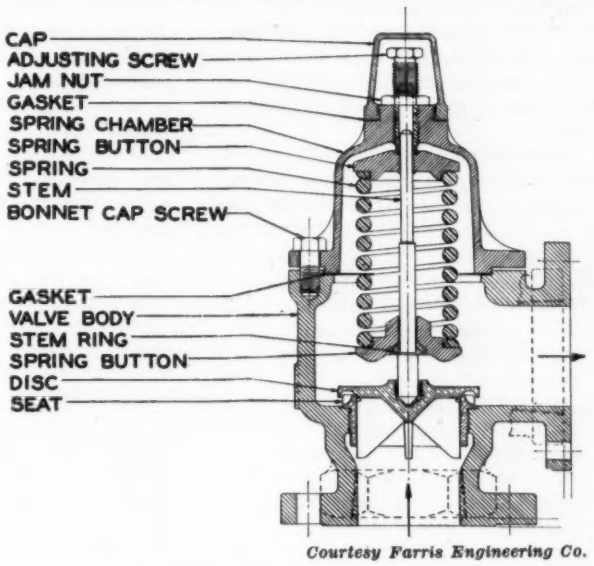
This group of four relief regulators serves to protect various fuel and refinery gas systems at the Torrance, Calif., refinery of General Petroleum Corp. by venting to a "smokeless" burning flare whenever excessive pressure develops in any of the systems. The relief valves are pilot operated for sensitivity, and incorporate a synthetic flexible tube connection in the main valve body to minimize leakage troubles. Explosion-proof electric switches can be seen mounted on the sides of the pilot valves; these sound an alarm whenever one of the valves operates

(1) "Design and Construction of Pressure Relieving Systems," Engineering Research Institute Bulletin No. 31, University of Michigan Press, 311 Maynard St., Ann Arbor, Mich. Available at $3 per copy.



Courtesy Johnston & Jennings Co.

Fig. 6—Weight-loaded relief valve of the lever type



Courtesy Farris Engineering Co.

Fig. 7—Spring-loaded relief valve of the wing-guided type

and that, during an adiabatic expansion they would require less area than determined by this formula and some corrections should be permissible.

Recommended Formulas for Vapor Flow: Equation 5 assuming adiabatic and reversible flow of an ideal gas through a nozzle or orifice is recommended to obtain ample relief area when sufficient pressure differential for critical flow is available. Since Equation 5 gives a relief area greater than that calculated from the thermodynamic properties of actual gases, Equation 7 employing a compressibility factor (Z) at the conditions in the throat,

$$W = 315\ apC\ (M/ZT)^{1/2} \quad \ldots\ldots\ 7$$

or Equation 8 employing the ratio of the specific heats at atmospheric pressure, may be used.

$$W = 735\ apC\sqrt{\frac{M}{T}\left(\frac{k}{k-1}\right)\left[\left(\frac{2}{k+1}\right)^{\frac{2}{k-1}} - \left(\frac{2}{k+1}\right)^{\frac{k+1}{k-1}}\right]} \quad 8$$

Where insufficient pressure differential is available to insure critical flow, Equation 9 should be used.

$$W = 735\ apC\sqrt{\frac{M}{T}\left(\frac{k}{k-1}\right)\left(\frac{P_2}{P_1}\right)^{\frac{2}{k}}\left[1-\left(\frac{P_2}{P_1}\right)^{\frac{k-1}{k}}\right]} \quad \ldots\ldots\ 9$$

In these equations:

k = ratio of the specific heats, at conditions approximating ideal gases

P_2 = pressure in the nozzle or orifice throat, may be approximately equal to the absolute backpressure

P_1 = absolute pressure of the vapor at inlet conditions.

When relief devices are to be used on a given fluid for which the thermodynamic properties are available, the rigorous thermodynamic calculations may be used.

Liquid

The flow equation for sub-cooled liquids, as applied to relief devices, is derived in the bulletin from the basic thermodynamic fundamentals. This equation is:

$$Q = 38\ aC\ (\Delta p/G)^{1/2} \quad \ldots\ldots\ 10$$

In this equation:

Q = liquid capacity, gal./min.

a = theoretical orifice area, sq. in., for C = 1.0
= actual orifice area, sq. in., for other values of C

C = coefficient of discharge

Δp = pressure drop across relief devices, psi

G = specific gravity; density of fluid, gm./cu. cm. divided by the density of water in gm./cu. cm. at the same conditions.

A review of the derivation shows that the use of Equation 5 for the flow of sub-cooled liquids can be questioned only in the selection of the proper coefficient of discharge (C).

Area Calculation for Saturated Liquids: The flow of a saturated liquid through a nozzle or orifice does not completely depend on the pressure drop available. A saturated liquid exhibits the same critical flow phenomena as vapor due to the expansion or vaporization of the saturated liquid at the reduced pressures in the nozzle.

A safe estimate would be to consider the saturated liquid as vapor at the upstream conditions and use the vapor flow equation.

Determining Relief Device To Be Used

Selection of the proper relief device for a given service requires a knowledge of the physical properties and behavior of the fluid to be relieved. The desired operating conditions and the equipment design specifications also must be available to

THE AUTHORS

Nels E. Sylvander is research engineer, Engineering Research Institute, University of Michigan, Ann Arbor. Donald L. Katz is Professor of Chemical Engineering, Department of Chemical and Metallurgical Engineering, University of Michigan.

the engineer specifying the relief device. With these properties and conditions available, one can then proceed to specify a relief device, or devices, for a given capacity in any service.

A recent survey of the refining industry investigating pressure relieving systems disclosed that many varieties of equipment are currently in use. A majority of the devices manufactured can be classified under the following general headings:

1. Weight-loaded relief valves
   a. Weight and lever type
   b. Direct-loaded type
2. Spring-loaded relief valve
   a. Bottom wing-guided valve
   b. Nozzle-type reaction valve
   c. Other spring-loaded types
3. Pilot-operated relief devices
4. Rupture or frangible discs
5. Substitutes or supplementary devices

Weight-Loaded Relief Valves

This type of relief device is probably the oldest in use today. Because of inherent characteristics, it is used primarily for moderate capacities, moderate temperatures and pressures to about 50 psi.

This valve may be used to advantage for low pressure ranges and services which would not require a spring-loaded type. This device generally has a weight at one end of a pinioned lever and the valve stem attached to the lever at an intermediate position between the pinion and the weight. Accordingly, a falling motion of the lever closes the valve and excessive force on the underside of the valve disc tends to raise the lever and the weight. Because of this construction, all points where friction could occur should be carefully inspected and close clearance spaces kept comparatively clean. Fig. 6 illustrates a "still"-type, weight and lever relief valve.

The operating pressure of a weight-loaded valve can easily be altered to another pressure setting. It is even possible to effectively gag the valve by overloading the lever arm with excessive weights.

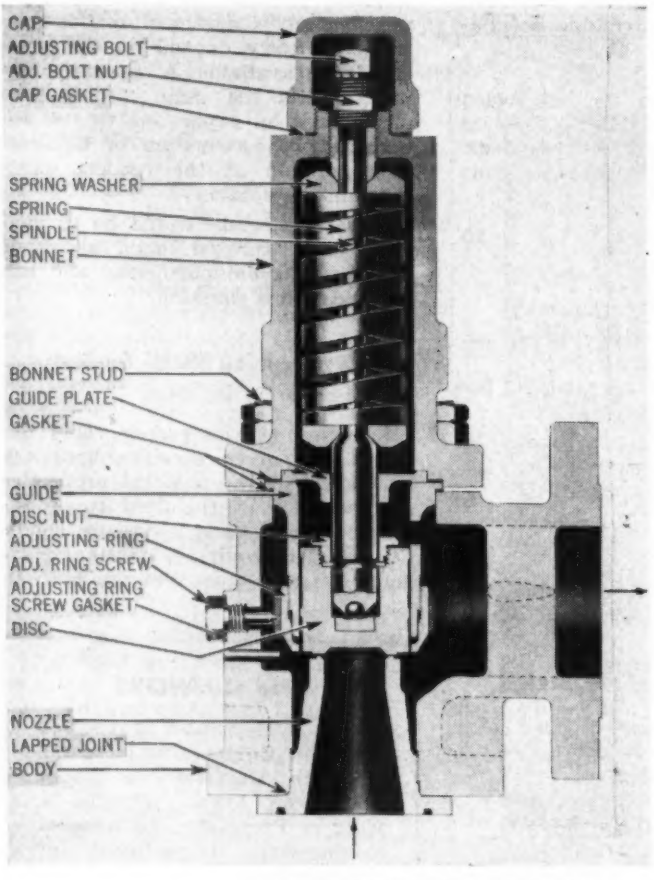
The lever when positively connected to the disc does permit manual operation of the valve for a check on operational dependability or for emergency use.

All weight-loaded relief valves are not of the lever type. Some are direct loaded with additional weight being placed directly on top of the valve disc or pallet. In some instances an exceptionally heavy disc serves as the weight in maintaining pressure. Occasionally ball check valves are used as weight-loaded relief valves of this type. A direct loading method is used particularly for large diameters to secure a better load distribution from the pallet or disc to the seat.

Spring-Loaded Relief Valves

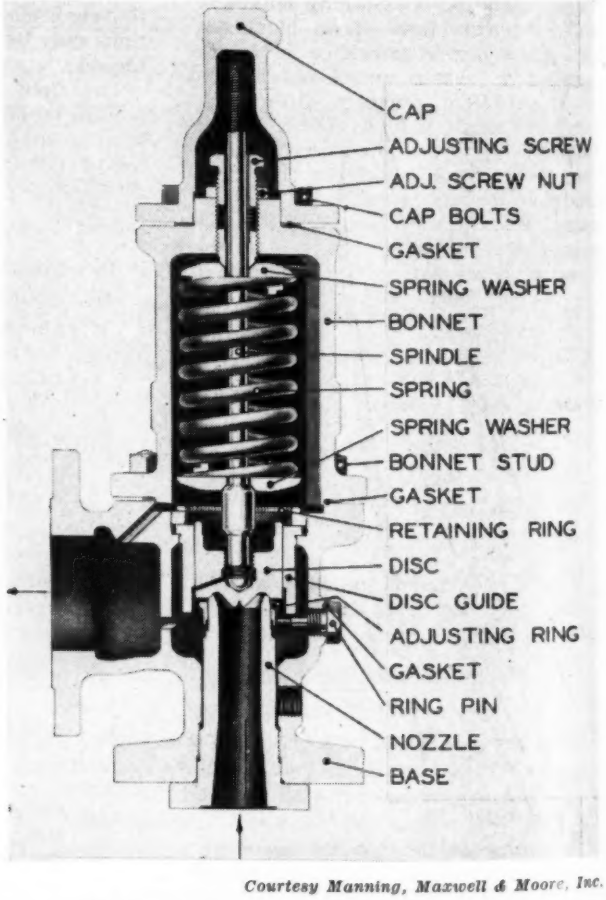
Early improvements of spring-loaded relief valves incorporated a so-called "huddling chamber" which gave the advantage of securing an additional lift. This type of device will be referred to as the wing-guided, spring-loaded relief valve. A later improvement was made when a truly reaction principle was employed, as in the high-lift nozzle-type device now manufactured for refinery service. The latter device will be referred to as the nozzle-type reaction relief valve.

1. Wing-guided Relief or Safety-relief Valves: The capacity of valves of this type will vary with the distance the disc lifts off the seat. At the 10% overpressure allowance permitted in refinery practice, the restriction to vapor flow in an ideally designed valve of this type would be the actual free throat area; that is, the area of the throat insert less



Courtesy Crosby Steam Gage & Valve Co.

Fig. 8—Nozzle-type relief valve designed with flat-seating surfaces



Courtesy Manning, Maxwell & Moore, Inc.

Fig. 9—Nozzle-type relief valve designed with outside-beveled seating surfaces

the cross sectional area of the wing guides. Many valves of this type are designed so that this condition is approached. However, there are variations of this type of valve which do not incorporate the "huddling chamber" principle and as a result may require overpressures as high as 50% to secure sufficient lift on the disc to permit full capacity flow. Valves of this type construction compare with the low-lift spring-loaded types to be discussed later.

Bottom-guided construction may require frequent removal of deposits between the guides and seat bushing as well as a check on the initial opening pressure.

Fig. 7 illustrates a wing-type bottom-guided relief valve. This type of valve is used in both liquid and vapor service at medium temperatures. It is generally equipped with a blow-down ring and designed to have pop-action when used for vapor. These valves can be equipped with lifting gear suitable for installations with or without backpressure. When so equipped, they may serve as drop-out valves in addition to their service as pressure relief valves.

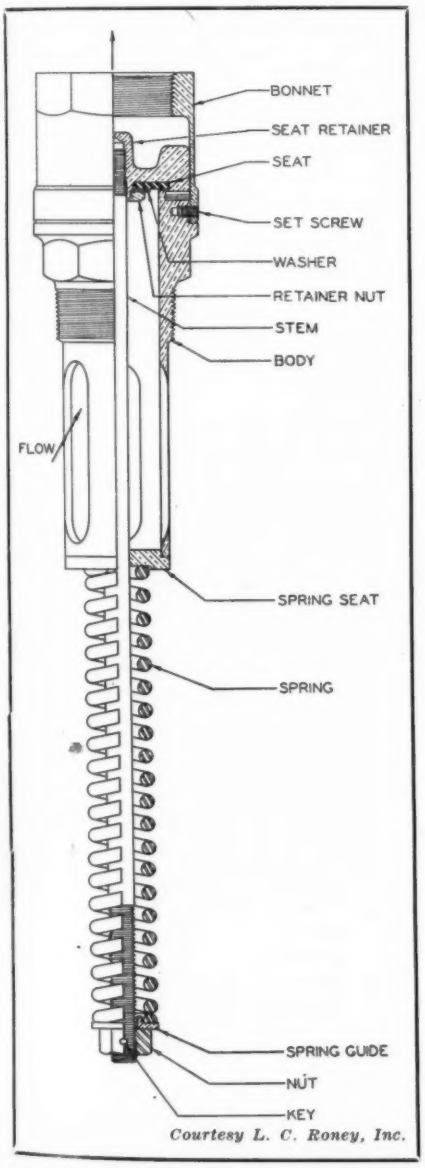


Fig. 10 — Light-product storage relief valve

These valves can be gagged with the use of an appropriate attachment which can be secured from the manufacturer. Gagging is only advisable when the protected equipment is being tested at a pressure above the relief device setting. The use of a gag to force the disc onto the seats if leakage is occurring is an unsafe practice and should not be considered. Such indiscriminate use of the gag may result in deformation of the stem or in scoring of the seating surfaces.

2. Nozzle-type Reaction Relief or Safety-relief Valves: The construction of these top-guided valves causes the escaping fluid during operation to be deflected with one or more changes in direction, thus directing a reactive force upward on the disc. During operation, the disc is first raised to a moderate height by the "huddling chamber" effect and then the reaction effect takes place, forcing the disc to a sufficiently high lift so that the nozzle or throat area becomes the restriction to flow. These valves when properly designed can secure this high lift with vapor for only a 3 to 5% pressure accumulation in the equipment protected, while 25% accumulation is required for liquid service.

Figs. 8 and 9 illustrate nozzle-type, top-guided valves with flat and beveled seating surfaces. The recent survey of the refining industry on pressure relieving systems showed that refiners are equally divided on the advantages or disadvantages of flat seats and beveled seats.

These valves can be equipped with lifting gear which will permit manual relieving for emergency dropout or for an operability check. Valve manufacturers have designed this lifting gear so that any tampering causes the relief valve to operate at a lower pressure. These relief valves can also be provided with gags which permit testing the protected equipment above the relief valve set pressure.

3. Other Spring - loaded Relief Valves: A relief valve designed primarily for use on pressure storage vessels, Fig. 10, has received considerable acceptance in the liquefied petroleum gas industry. The design of this valve permits all of the working parts to be located inside the tank, eliminating high projections on the vessel. As the spring adjustment

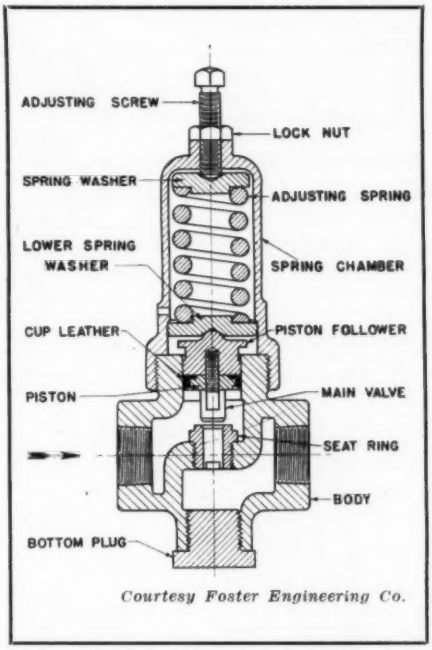


Fig. 11—Low-lift expansion relief valve

nut is inside the vessel, tampering is eliminated. This type of device may not reach capacity flow at 10% overpressure; therefore its use on vessels in refineries is limited.

A small spring-loaded valve, widely used to relieve hydraulic or vapor pressure where only a small flow is required, is manufactured by many companies. Capacity is not the chief requirement for these devices but merely some means of achieving a degree of relief. Applications would be in protecting pipe lines or heat exchange from thermal expansion. One relief valve of this type is illustrated as Fig. 11.

Pilot-Operated Relief Devices

These devices are so constructed that larger capacities for a given inlet size can be realized than with the spring-loaded nozzle-type relief devices. The pressure under the disc is opposed by the sum of an equal pressure on the upper side of the disc plus a spring pressure of approximately 75% of the desired opening pressure. When the opening pressure is reached in the vessel, a pilot valve quickly releases the compressed vapor from the top side of the disc in the main valve, permitting the valve to immediately pop to a wide-open position as the force acting downward on the disc is now only 75% of the force acting upward. This construction permits the inlet nozzle and disc to be of the same dimensions as the inlet piping. These valves, however, are equipped with soft seats and at present are suitable only for low temperature and pressures up to 100 psi.

A pilot-operated pressure relief device which has received acceptance

on liquefied petroleum gas storage vessels in refineries is shown in Fig. 12. Any failure of the pilot valve permits the main valve to relieve at 75% of the desired opening pressure. These valves can be relieved using a test lever which is supplied.

Rupture or Frargible Discs

Rupture discs are designed to give a full bore opening when over-pressure exceeds the bursting strength of the disc. Discs of various types and constructions have been used with a degree of satisfaction. The present discs in general use in the refining industry are pre-formed plate or sheet metal discs. These devices require a greater margin between the operating pressure and the set pressure than safety or safety-relief valves to avoid rupture for minor pressure excesses. Unless this precaution is observed there may be premature failure at operating pressures. The behavior of the discs due to temperature depends upon the type of metal used, with some types weakening at elevated temperatures and increasing in strength at relatively low temperatures. Periodic replacement programs to avoid fatigue failures give reasonable success.

Frangible discs have found considerable use in corrosive service either in place of a conventional relief device or as protection on the inlet side of the conventional valve. A typical frangible disc installation is shown in Fig. 13.

Substitutes or Supplementary Devices

Many installations have diaphragm-operated flow control valves in addition to the conventional safety devices. These control valves are installed so as to maintain a pressure below the opening pressure of the relief device for minor upsets. No objection is made to the use of flow control valves as auxiliary pressure relief equipment.

The need for large capacity flow at low pressures has caused some companies to use liquid seal legs. A properly designed seal leg can be considered as a positive operating relief device. Engineers have devised ingenious arrangements for maintaining the seal or to re-establish the seal after a blow through.

In a relatively few installations, the possibility of internal reactions has prompted some refiners to install a blow-out plate or section. This plate is either of a lighter gauge metal or has a very light weld holding it in place. When pressure surge occurs, the plate is expected to fail and thus permit an extremely large vent area.

Fusible plugs are not looked on with favor for pressure vessels in the refining industry. They are occasionally considered for particular installations but do not merit a discussion here.

Location and Mounting Of Relief Device

Relief devices should always be installed in a manner which will permit them to operate at full capacity. No other major restriction to flow should be permitted in the connecting piping.

Relief devices may be located on a nozzle directly off a vessel or anywhere on a pressure unit*, where they cannot be isolated from the vessel or unit during an occurrence of overpressure. Relief devices in a single location can be considered as protecting a pressure unit only if a complete analysis shows the capacity requirements for overpressure relief to be satisfied.

The installation of a relief valve directly on nozzles from pressure vessels is common practice. Where several valves are required for a given pressure vessel or unit, the valves may be installed on a manifold attached directly to a nozzle from the vessel. There can be no constriction in such a manifold which would interfere with the operation of the valves at capacity flow. The advantages in constructing a vessel with one large nozzle and then using a

*Vessels connected together in a system with adequate piping containing no valves which would permit any of the vessels to be isolated while still connected to its pressure source, may be considered as one unit.

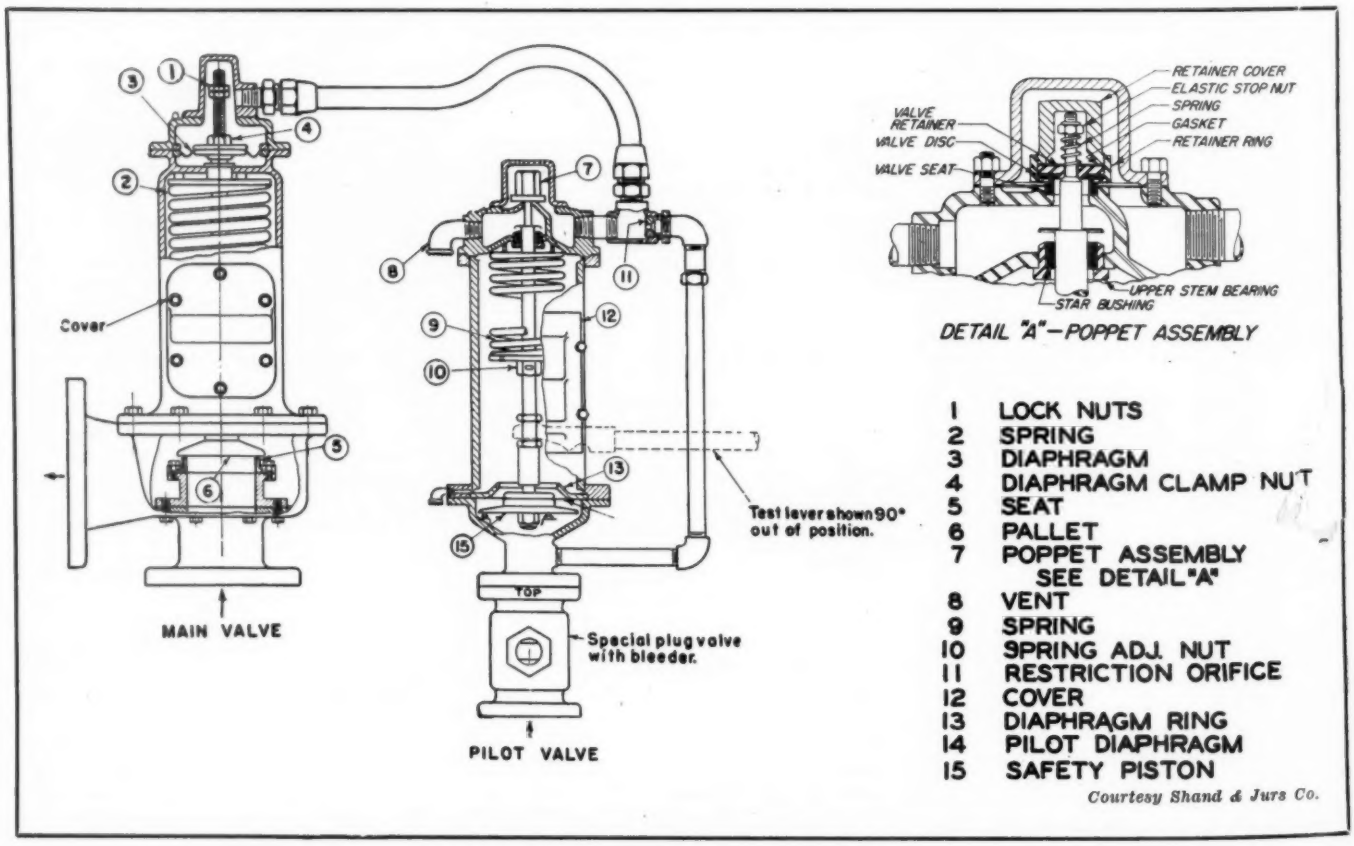
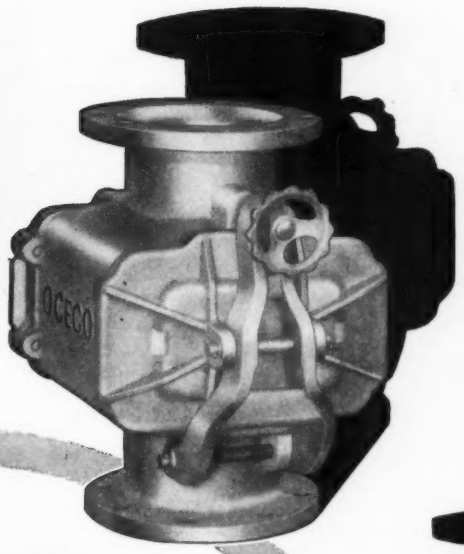


Fig. 12—Pilot-operated pressure relief valve

Oceco 2" Flame Arrestor Showing Screw Mounting and Side Hinge.



Oceco 6" Flame Arrestor Showing Flange Mounting and Bottom Hinge.

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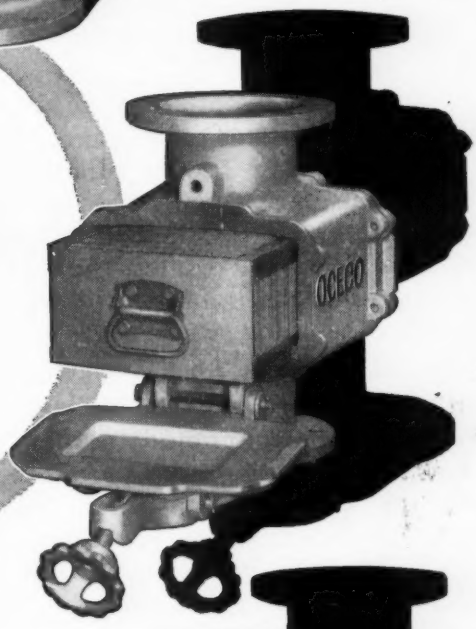
Below—View of Oceco Type "F" Fixed Bank.



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Above—View of Oceco Type "E" Extensible Bank.

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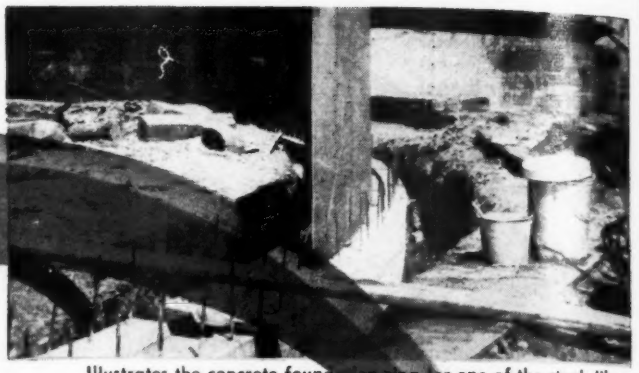
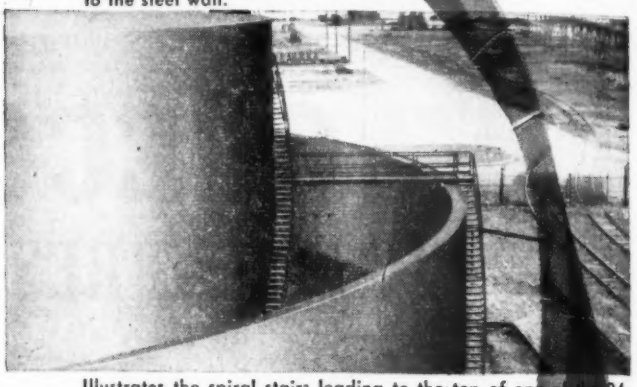
The HAMMOND STEEL DIKE and STORAGE TANK INSTALLATION, illustrated, was designed and erected for the Coastal Oil Company at their Port Newark terminal. Each of the three cone roof tanks has a capacity of 96,000 barrels and each dike has the equivalent capacity. The tanks are 48 feet high and 120 feet in diameter and the dikes are 24 feet high and 172 feet in diameter.

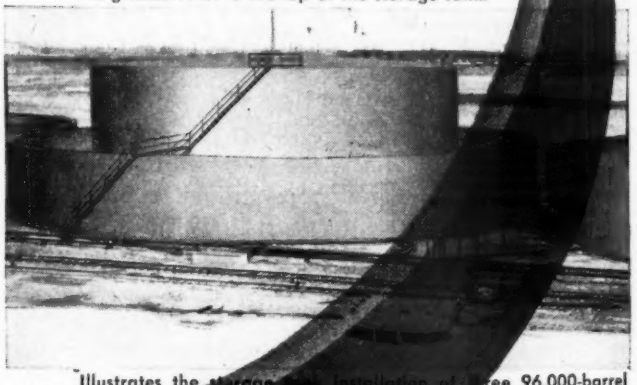
Conventional earthen dikes would have required at least six acres more ground space than was used for these steel dikes and costs of reinforced concrete dikes would have been much higher.



1. Illustrates the concrete foundation ring for one of the steel dikes, with part of the first ring of steel plates in position. After a steel dike wall is erected and welded, the reinforcing bars, shown extended above the concrete ring, are bent over and welded to the steel wall.



2. Illustrates the spiral stairs leading to the top of one of the 24-foot-high steel dikes and also the walkway leading from the dike to the shell of the tank and tank stairs which extend from the ground level to the top of the storage tank.



3. Illustrates the storage tank installation of three 96,000-barrel cone roof tanks with the steel dikes, 24 feet high and 172 feet in diameter.

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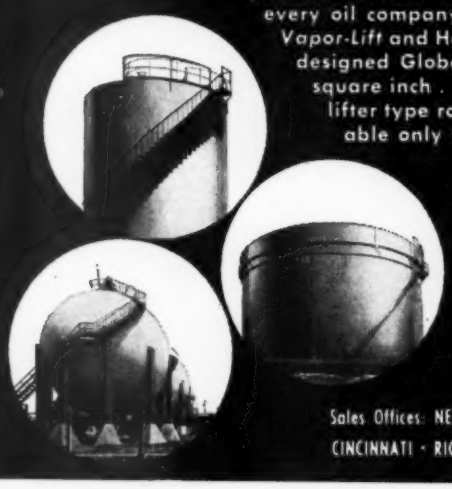

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manifold are in economy of vessel design and in permitting a more accessible location of relief devices.

That portion of the vessel should be selected for nozzle location where a minimum of fouling may occur. On fractionating equipment, relief devices can be installed on the top vapor space, bottom vapor space or at the feed flash section. Any one of these locations would be suitable for vapor relief on light hydrocarbon process vessels or the needed relief area may be divided among them. The bottom vapor space might be questionable if the liquid level should rise above the relief device inlet during a misoperation requiring pressure relief. Relief devices located on fractionating towers may also serve overhead receivers and side receivers venting into the tower, providing no block valves exist in the connecting lines. On heavy petroleum-fraction processing units, both the feed flash section and bottom vapor space may be objectionable locations as serious tar or coke deposits may occur in the relief device inlet.

Operating vessels or accumulators which generally operate partly filled with liquid should have the relief devices mounted on top. Among the advantages of a top location is the removal of non-condensible gases by operation of relief devices. This location would satisfactorily care for the release of generated vapors. If the overpressure cause were an accumulation of non-condensible gases, the cause would be removed when the relief devices operated.

Operating vessels normally liquid full could have the relief device mounted at any convenient location if the relief requirement is not for vapor generation. However, since valves have a much greater volumetric relief capacity for vapor, the top position would be preferred as vapor generation from fire exposure always appears to be a possibility.

Relief devices may sometimes be placed at a particular location on a vessel or pressure unit so that they are in contact with a less corrosive fluid than at an alternate location.

Relief devices can be installed on that portion of a vessel or pressure unit at which overpressure is most likely to originate to provide rapid pressure relief and possibly to eliminate operational upsets further downstream in the unit under consideration. This practice should be favored providing other difficulties are not introduced.

The installation of relief devices on lines to or from a particular vessel may be more advantageous and economical. This method of installation is permissible provided; a reasonable assurance exists that no stoppage can occur between the vessel and the relief device inlet; and, that the line on which the relief device is located can provide ample capacity for the device. Relief devices should not be used on a line from a vessel if this line is regularly blinded off between the vessel and the device location during maintenance periods.

It is believed that the location of relief devices on vapor lines from towers is quite satisfactory, providing adequate mechanical re-enforcement is supplied. The vapor line location would normally require that relief devices be located at varying heights above the ground level as they must be installed ahead of condensing equipment. However, units which operate completely filled with liquid can have relief devices installed on the overhead line at a location relatively close to the ground level. Location at ground level permits considerable saving in inspection and maintenance time.

The overpressure protection required on uninsulated pressure vessels exposed to fire may involve many relief devices of large size. An installation protecting a group of such vessels used to store liquefied petroleum gas is shown in Fig. 14. The vessels as shown are within individual fire walls. Fluid leaking from any one tank accumulates only around that tank and, should ignition occur, the other three tanks will be submitted to less intense heat. Based on this method of reasoning, one relief valve, sufficiently large to handle the vapor generation within one tank and a portion of that within the adjacent tank, provides protection for two tanks.

Stop Valves at Relief Devices

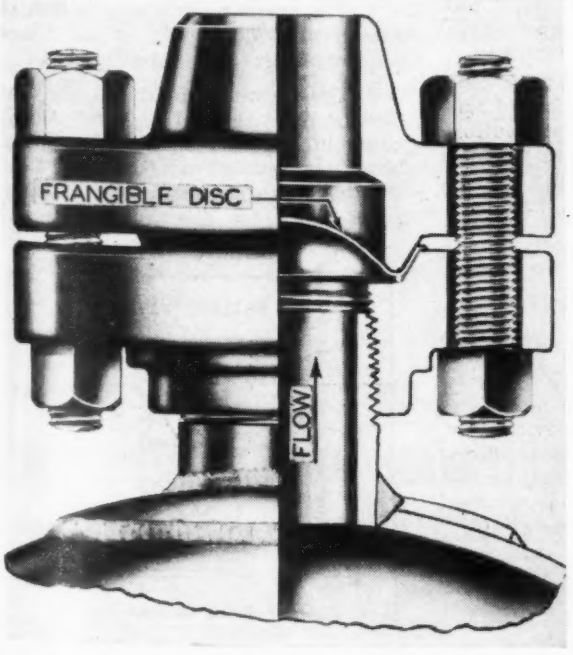
The fact that stop valves can be used advantageously beneath relief devices is recognized by the API-ASME Code. The provision in the code barring the use of gate valves is believed to be unnecessarily restrictive. Whenever gate valves are used, they should be of steel construction and of the rising-stem type.

There is general agreement among petroleum refiners that stop valves can be used with no increase in hazard, providing certain precautions are taken. Vessels provided with only the required relief capacity can have a stop valve installed in conformance with the API-ASME Code, provision 602c of each section.

The installation shown in Fig. 14 would conform with the code provisions. In this figure, the locked-open plug valves permit a relief device to be served without depressuring the protected tanks. The valves as shown also permit one vessel to be removed from service for inspection.

Refiners desiring to install stop valves beneath pressure relief appliances on equipment operating over 200° F. may do so under present code provisions. W-602a of the code permits stop valves between the equipment and its pressure relieving device where multiple relief devices are provided and the stop valves are so constructed that they cannot be operated so as to reduce the pressure relieving capacity below that required.

Satisfactory installations of stop valves between the vessel and the relief devices can be made on vessels operating above 200° F. and requiring a single relief device by installing duplicate relief devices either



Courtesy Black, Sivalls & Bryson, Inc.

Fig. 13 Frangible disc installation

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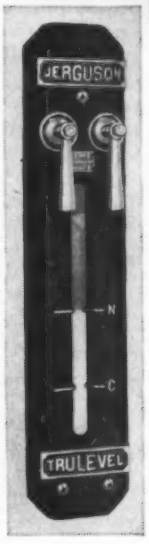

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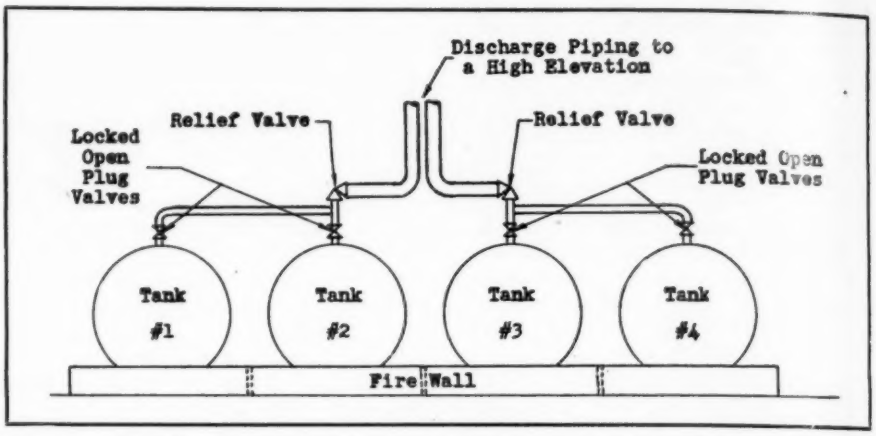


Fig. 14—A relief device installation protecting a group of liquefied petroleum gas storage vessels

on a three-way transflow valve* or on two stop valves from twin nozzles off the protected vessel.

Protection Against Corrosion And Plugging of the Inlet Side of a Relief Device

The inlet piping to relief devices can be safely modified to prevent corrosion and serious fouling. A satisfactory method of preventing corrosion on the under side of a relief valve disc is shown in Fig. 15. In this figure a 180° loop forms a trap which fills completely with liquid. To keep the trapped liquid from becoming corrosive a wash stream enters beneath the relief valve and flows back into the protected column. This wash stream can be a part of the top reflux or another suitable stream.

Frangible discs can be used beneath conventional relief valves to protect against corrosion. Satisfactory results are achieved if the proper disc material is selected and if the disc is replaced in accordance with an established inspection schedule.

Extremely viscous fluids may congeal in the inlet piping to relief appliances. A satisfactory precaution against this occurrence is in the use of external steam tracing and insulation of the inlet piping and inlet portion of the relief device.

Sizing of Inlet Piping

Pressure drop through inlet piping has a two-fold importance in relief system design. First, flow capacity varies with the pressure drop available. Secondly, the operating characteristics of many relief devices indicate that improper pressure drop on the inlet side may cause intermittent operation. Conventional spring-loaded relief valves have the rate of flow affected by the inlet pressure drop, since the pressure at the inlet to the valve will then be below the vessel pressure. If an excessive pressure drop occurs through the inlet piping, the valve tends to close prematurely. As the valve closes, pressure within the protected equipment builds up rapidly and the valve is forced open again. This action results in what is commonly referred to as "chattering." Chattering creates serious vibrational disturbances and can result in damage to the relief valve parts and possible failures of piping connections. Rupture discs and pilot-operated valves are not susceptible to intermittent operation. The rate of flow may also be decreased by large pressure drops through the inlet connections.

For a relief valve having approximately 4% blow-down (i.e., one in which the valve will snap shut when the pressure has decreased to 4% below the opening or set pressure) these recommendations are made:

1. The pressure drop due to friction should not exceed 1% of the allowable pressure for capacity relief.

2. The presure drop due to the conversion of pressure to kinetic energy, commonly referred to as velocity head loss, should not exceed 2% of the allowable pressure for capacity relief.

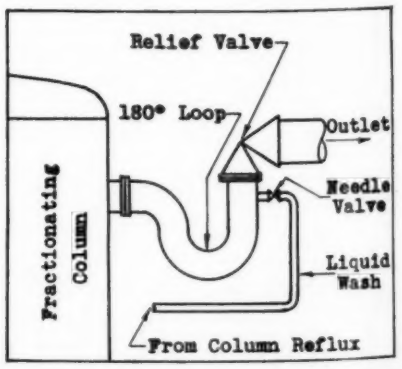
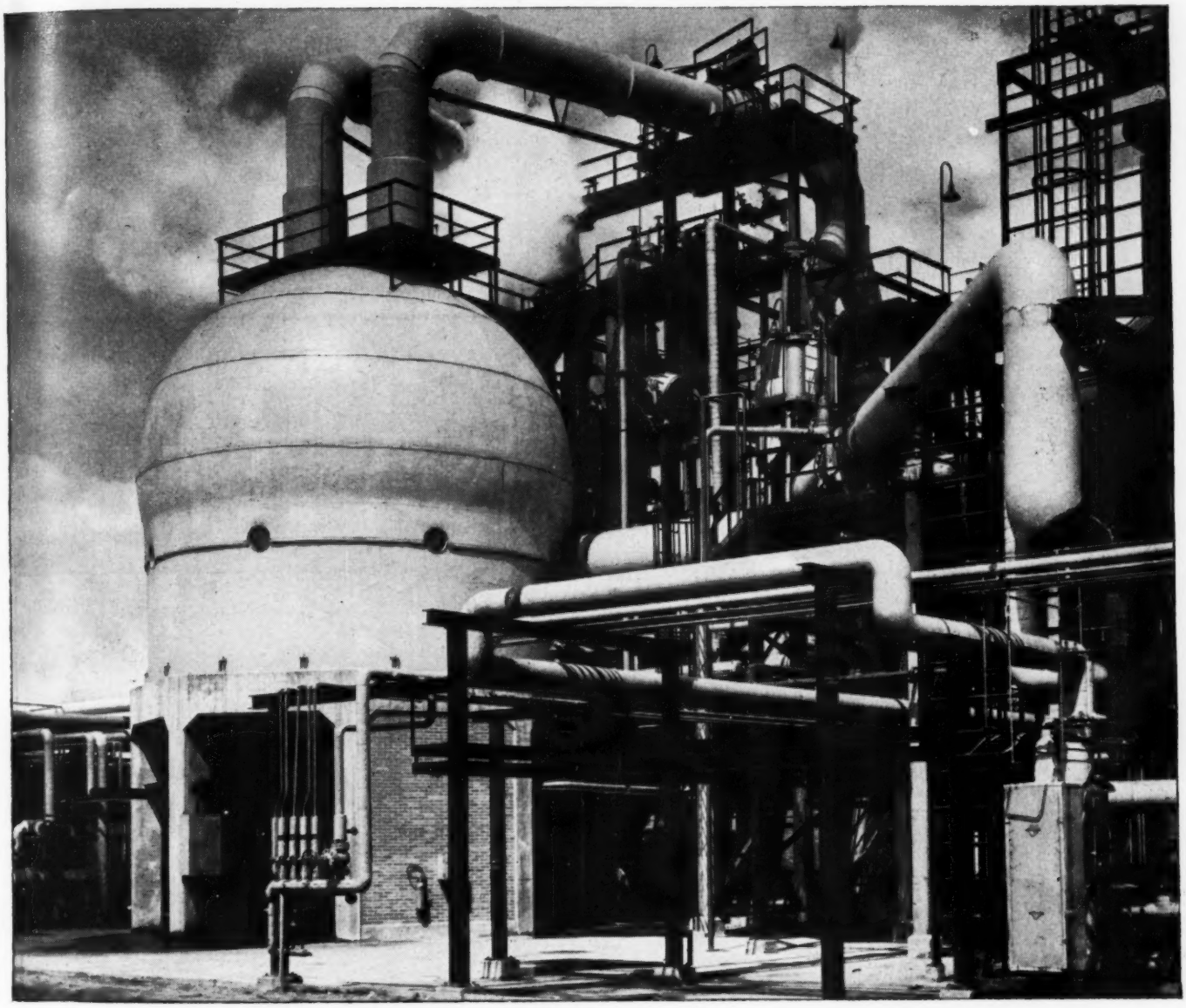


Fig. 15—Liquid seal for corrosion protection

*The transflow valve is of special construction so that a minimum area equal to that of one outlet port up to the combined area of both outlet ports is available for flow at any position of the valve.



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The new vacuum flash unit shown in the above view was built to furnish feed to the Shell Oil Company's twin 15,000-b/d fluid cracking units at their Wood River, Illinois, refinery. In designing the new flasher, there were three prime considerations, of which adequate throughput was the first. The second was to build a unit capable of long on-stream periods, readily accessible for maintenance. The third was economical construction.

To meet these requirements, a 30-ft. diam. alloy-steel-clad sphere was fabricated to Shell's general specifications, having internal baffling to separate vapor and liquid, and a liquid leg 4 ft. in diam. by 6 ft. long, instead of the conventional cylindrical chamber. It has a capacity of 35,300 bbls. per day, and is designed to operate at 60 mm. Hg. absolute pressure.

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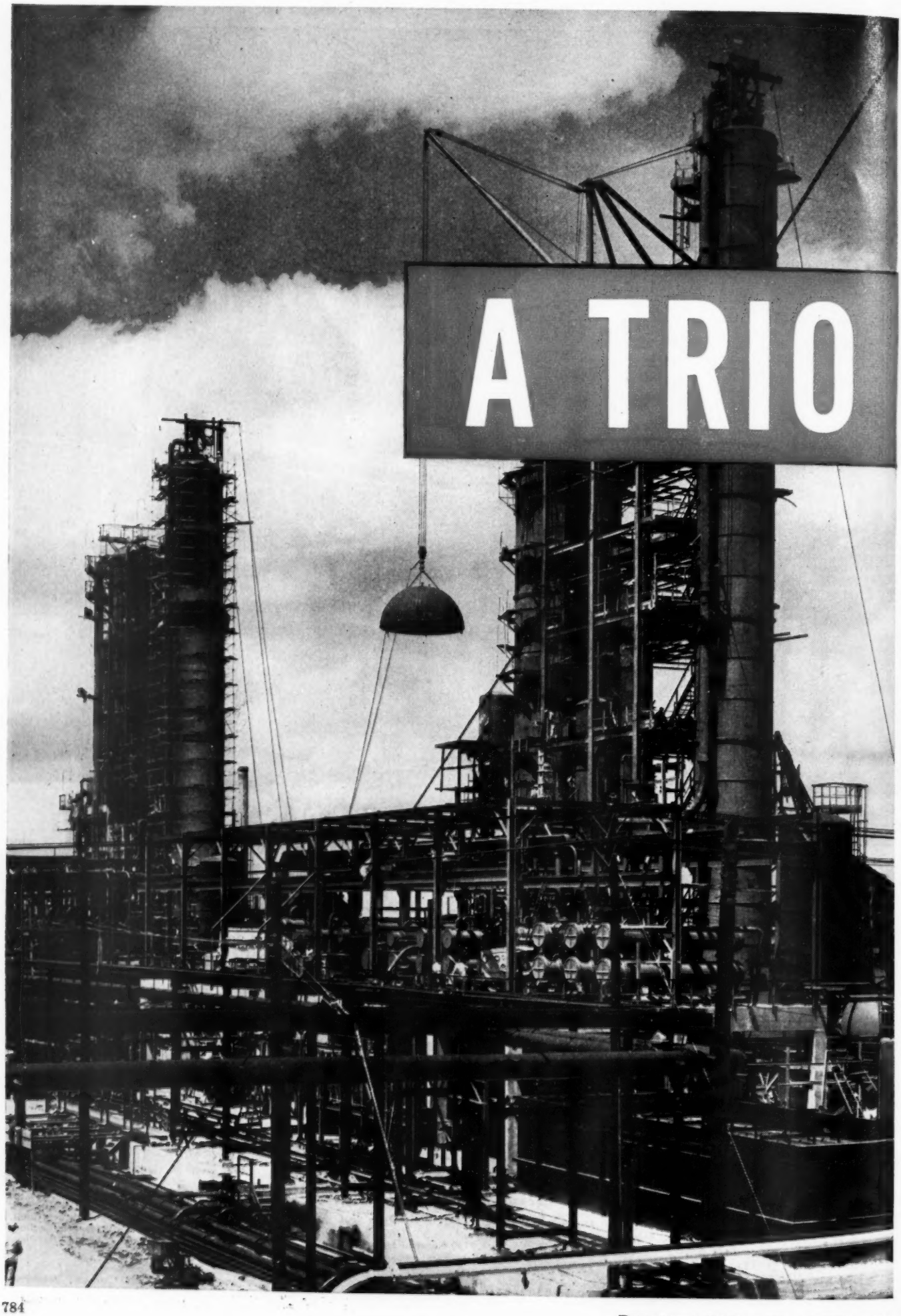
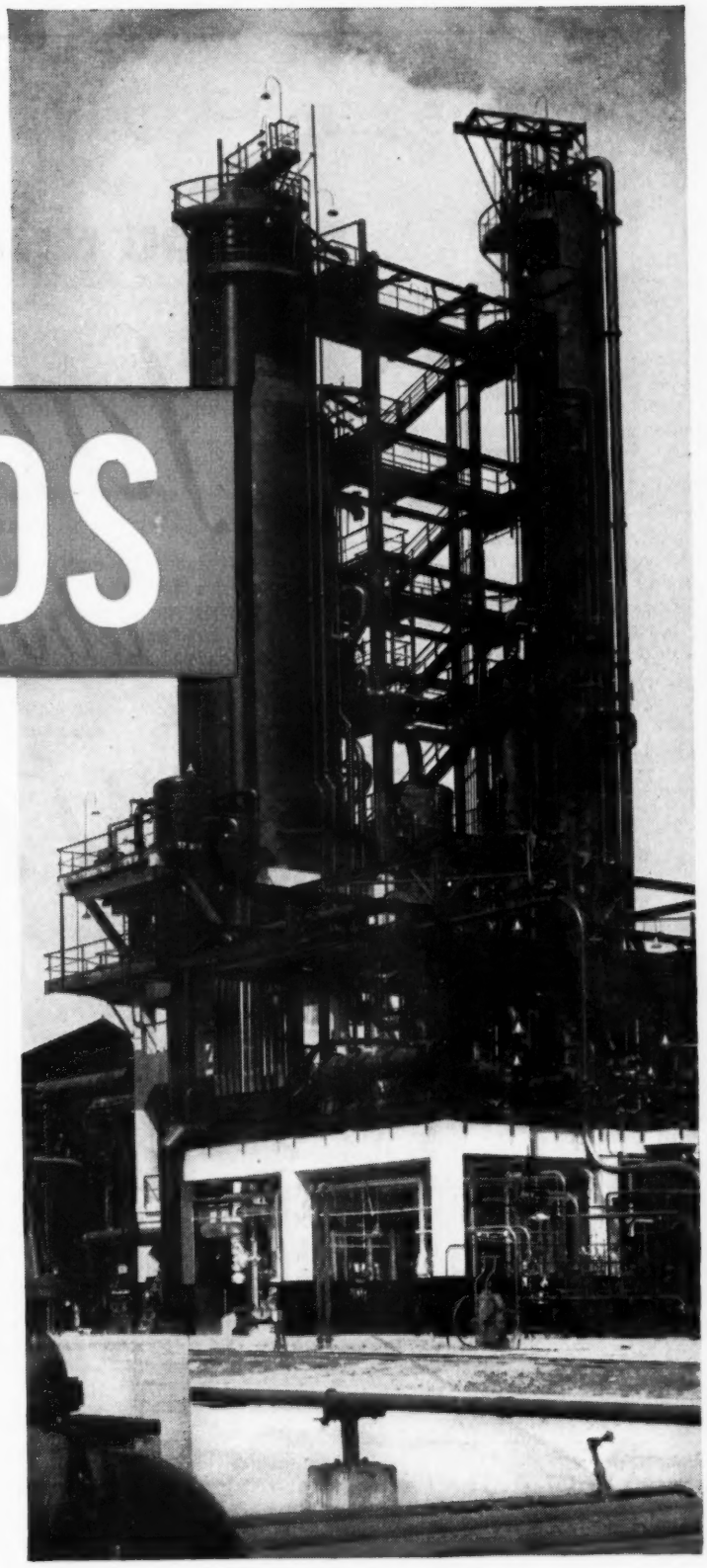

A TRIO



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Patent Trends in Petroleum Refining

By PETER J. GAYLOR

Patent Attorney and Editor "The Technical Survey"

Odorless Solvents

THERE has been a trend lately toward the production of "odorless" or "non-polar" solvents, and a number of firms have shown some activity in this field.(1)

The products falling in this category, which are being introduced for dry cleaning and indoor painting, are usually paraffin hydrocarbons as free as possible from polar compounds such as aromatics and olefins. Branched chain hydrocarbons appear to be preferred. McArdle (2) already has pointed out the unique viscosity characteristics of these hydrocarbons in comparison with others, which makes them particularly useful as paint thinners.

In view of the wide expansion in alkylation operations during the war, and even at present, this type of treatment is available to provide large quantities of branched paraffins, if and when they are needed for such purposes. In its U. S. Patent 2,442,011, Phillips Petroleum Co. describes a method for producing substantially odorless fractions of branched chain paraffins, having the desired boiling range, particularly by a process employing a single fractionating column.

For example, it starts with a heavy alkylate fraction having an API gravity of 50.9° and the following distillation characteristics:

Init. b. pt.	43° F.
10%	378° F.
50%	398° F.
95%	570° F.
End pt.	597° F.

This alkylate is employed as feed to a conventional plate type fractionation column having 20 plates of large liquid capacity (as shown in Fig. 1). During introduction of the feed, the column is operated under total reflux conditions. When flooding of the plates is imminent, introduction of feed is discontinued and operation of the column under total reflux is continued until equilibrium is established between liquid on the various plates and the vapors in contact.

Tests of the liquid on the various plates of the column show that the concentration of odorous materials is highest on the uppermost plates. There is a gradual decrease in odor in the lower plates, until substantially all odor is absent from plates below the 17th. Liquid on plates below the 17th is so free of odor that distilled water must be employed as the standard for comparison.

The odorless fractions desired are those boiling in the ranges from 390° to 430° F., and 430° to 597° F. These are obtained by draining selected plates of the column below the 17th plate.

Separating Hydrocarbons By Adsorbents

In many operations (such as those outlined above), it is desirable to remove normal paraffins from refinery gaseous or liquid hydrocarbons. As discussed in a previous article,(3) Prof. Barrer of England has been successful in making a separation of "sieving" or branched and straight chain paraffins by means of selective adsorption on chabazite.(4) This natural mineral occurs only to a small extent in nature, and various attempts are being made to synthesize a similar product.

In its U.S. Patent 2,442,191, Standard Oil Development Co. discloses that a mixture of hydrous oxides of aluminum and silicon with a hydroxide or oxide of a group II metal, such as calcium oxide, is capable of reacting together to give a substance exhibiting specific adsorption capacity for normal paraffins, if the said oxide and hydroxide are heated, preferably with a solution

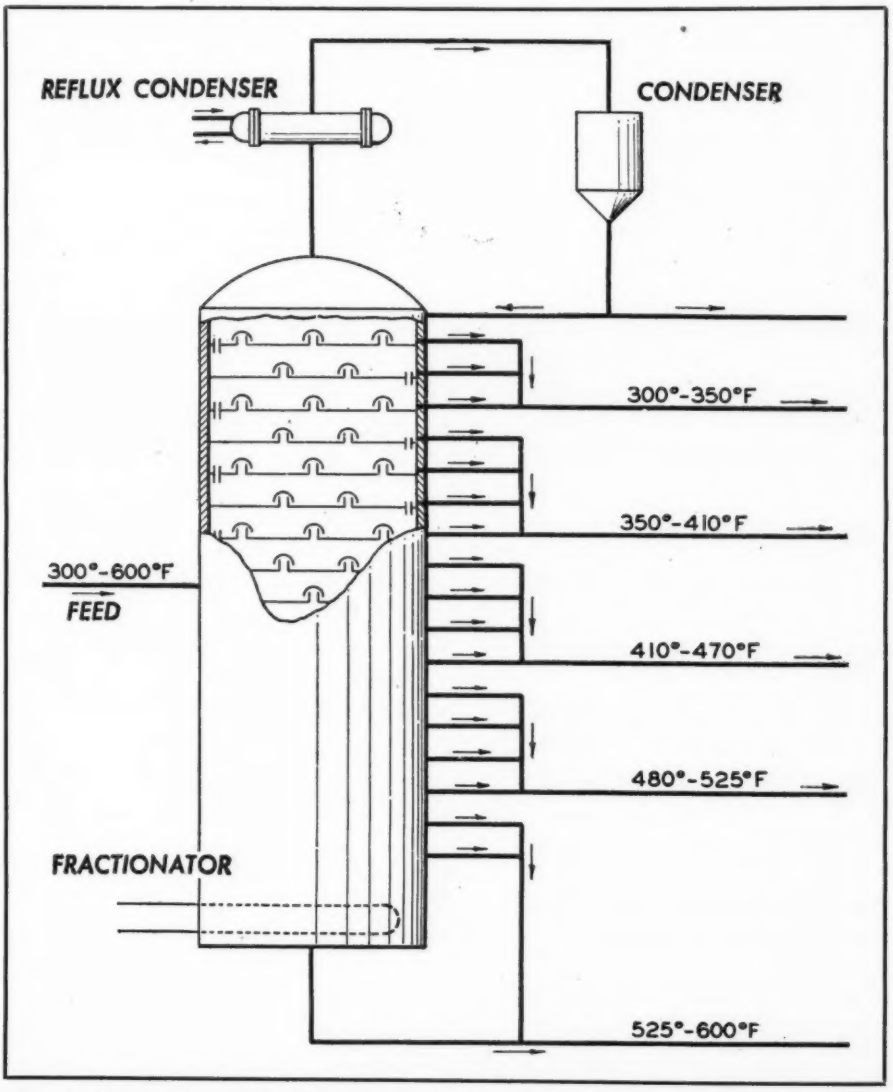

Fig. 1—Conventional plate-type fractionating column having 20 plates of large liquid capacity employed by Phillips Petroleum Co. to separate "odorless" solvents from a heavy alkylate fraction (U. S. 2,442,011)

of a salt of the group II element, to a temperature of 220° to 400° C.

One such product, produced in a pressure bomb, washed with distilled water and dehydrated in vacuum at 500° C, was found to absorb, at 100 mm. pressure, the following amounts of gas, expressed as cc/gm. of product, corrected to 0° C. and 1 atm. pressure:

	n-butane	iso-butane
176° F.	4.5	...
230° F.	4.1	0.22
270° F.	4.1	0.26
424° F.	2.2	0
491° F.	1.3	0

Experimental results indicate that the most favorable synthesis conditions involve employment of high concentrations of a group II salt in the liquid phase charged to the bomb. The solid adsorptive material has the empirical formula:

$$4CaO \cdot Al_2O_3 \cdot 4SiO_2$$

Another separation method recently patented by Sun Oil Co. (U.S. Pat. 2,441,572) involves the separation of aromatics from other hydrocarbons by adsorption on silica gel. In connection with the work, this firm has adopted the term "adsorption index" which may be defined as the apparent number of cc's of the compound adsorbed by 1 kg. of the adsorbent when the latter is in equilibrium with a solution consisting of the compound and the secondary desorbing agent employed in the process, which solution contains 0.2% of said compound by volume.

The following table gives the absorption index of a number of compounds:

Primary Liquid	Secondary Liquid	Adsorption Index of Primary Liquid
methylcyclohexane	n-heptane	0.2
carbon tetrachloride		0.8
benzene		8
ethylene dichloride		18
ethyl ether	methyl cyclohexane	68
acetone		160
methyl alcohol		196

The patent describes a cyclic process involving treating the mixture to be separated, with silica gel to adsorb the aromatics, washing the adsorbent with an organic primary liquid desorbing agent (of not higher than 40 absorption index) to displace the aromatics, then washing with a secondary desorbing agent (a saturated hydrocarbon liquid) to remove the primary desorbing agent and reactivate the adsorbent for re-use.

New Cracking Catalyst Yields Gasoline Rich in Olefins

NEWER gasoline engines are requiring higher octane number fuel, particularly with respect to road rating at moderate speeds. Under such conditions, olefins in the fuel are especially desirable, at least in the lower boiling 50%.

One patent issued to Gulf Research and Development Co. (U.S. 2,441,974) discloses that the production of gasolines rich in olefins is possible by the use of a hydrated magnesium silicate-calcium silicate cracking catalyst used with a feed space velocity of about 4 volumes per volume of catalyst per hour.

In one case, a Pennsylvania gas oil was cracked, using such catalyst, at about 950° F., for a total of 36 cycles, when 23.5% by weight of the gas oil was converted, with yields being as follows:

	Wt. %	Vol. %
Yields*		
Hydrogen	0.1	..
Methane	0.5	1.3
Ethane	0.7	1.6
Ethylene	0.9	1.2
Propane	0.3	0.6
i-Butane	0.1	0.1
Propylene	1.0	1.7
n-Butane	0.1	0.1
i-Butylene	0.6	0.7
n-Butenes	0.9	1.2
Debut. 400° F. E.P. Gasoline	18.1	19.8
Recycle Oil (above 400° F.)	76.5	76.1
Coke	0.2	..

* Based on charge (100% wt. balance)

The gasoline had an octane number (M.M.) of 78.1 and 83.3 with 3cc TEL per gallon. Bromine number was 128.3 compared with 3.9 for the charging stock. The low amounts of gas and coke produced are noteworthy. The catalyst is more specifically disclosed in U. S. Patent 2,163,525.

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(2) McArdle, *Paint, Oil & Chem. Rev.*, 5/3/45, p. 8.

(3) Gaylor, *Petroleum Processing*, 3/47, p. 186.

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U.S. 2,442,060 (Standard Oil Dev.)—Aromatic hydrocarbons of high purity.

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U.S. 2,442,093 (United Gas Improvement)—Pyrolysis of fluid hydrocarbons.

U.S. 2,442,131 (SOD)—Dehydrogenation catalysts.

U.S. 2,442,160 (Socony-Vacuum)—Alkylation.

U.S. 2,442,218 (Jasco)—Isoolefin-diolefin interpolymers.

U.S. 2,442,221 (SOD)—Alkylation.

U.S. 2,442,229-30 (Gulf Res. & Dev.)—Separating chlorostyrene from chloroethyl-benzene.

U.S. 2,442,285 (Shell Dev.) — Dihalogenated aliphatics.

U.S. 2,442,319-20 (Dow Chem.)—Dehydrogenating olefins.

U.S. 2,442,342 (S. O. Ohio)—Isopropyl benzene.

U.S. 2,442,387 (Socony)—Circulating oil in bead-forming tower.

U.S. 2,442,418 (Phillips Petr.)—Isomerization.

U.S. 2,442,440 (Texas) — Stabilizing raw cracked naphtha and producing anti-knock gasoline.

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U.S. 2,442,644 (Calif. Res.)—Controlling viscosity of olefine polymers (with SO_2).

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U.S. 2,442,741 (Cities Service)—High viscosity damping fluid.

RE. U.S. 23,005 (Sun Oil)—Separation of hydrocarbons with silica gel.

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Brit. Appl. 8106/48 (SOD)—Catalytic process.

Brit. Appl. 8107/48 (SOD)—Synthesis of organic compounds.

Brit. Appl. 8225/48 (SOD)—Crankcase conditioning oil.

Brit. Appl. 8222-3/48 (Texaco Dev.)—Internal combustion engines.

Brit. Appl. 9949/48 (ICI)—Antifoaming compositions.

Brit. Appl. 9756/48 (Shell)—Cyclic thioethers.

Brit. Appl. 10009/48 (Shell)—Alcohols.

Brit. Appl. 10010/48 (Shell)—Bituminous compositions.

Brit. Appl. 10011/48 (Shell) — Cyclopentane carboxaldehydes.

Brit. Appl. 9728/47 (Shell)—Unsaturated acid halides.

Brit. Appl. 18998/47 (Shell)—Emulsion polymerization.

Brit. Appl. 19331/47 (Shell)—Conversion of hydrocarbons.

Brit. Appl. 931/48 (S. O. Calif.)—Compounded oil.

Brit. Appl. 1351/48 (Grey)—Synthetic petroleum.

Brit. Appl. 2554/48 (Stanco)—Highly efficient insecticide.

Brit. Appl. 21272/47 (Christiansen)—Activated adsorbing products containing silicic acid.

Brit. Appl. 3188/48 (Epel et al)—Self-sufficient fuel.

Brit. Appl. 1832-3/48 (Kellogg)—Hydrogenation of carbon oxides.

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FOR 67 YEARS, the aim of SOLVAY has always been to produce the finest in alkalies and associated chemicals.

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Floats Indicate Specific Gravity Continuously on Process Streams

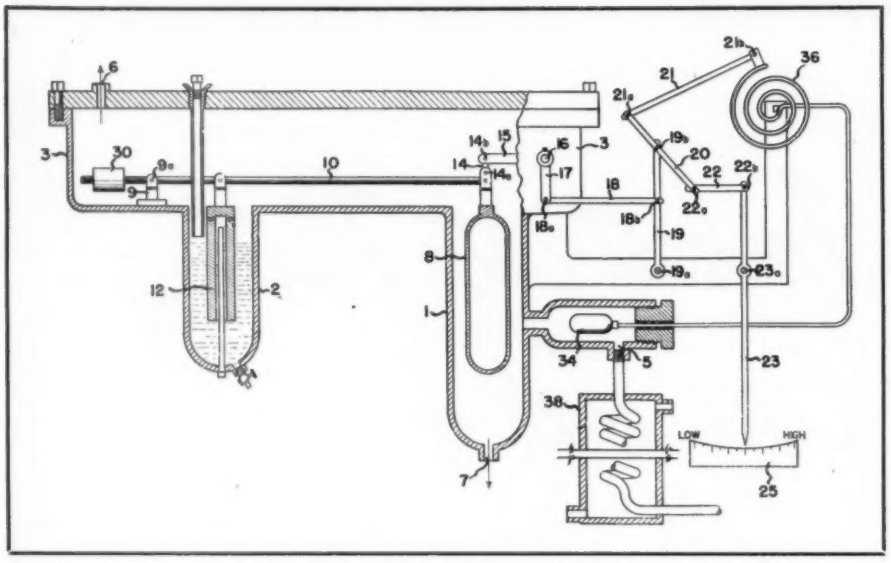


Fig. 1—One form of a continuous specific gravity indicator for hydrocarbon streams undergoing process operations (U. S. 2,442,039)

SPECIFIC GRAVITY of flowing streams of hydrocarbons in a process—regardless of temperature and pressure conditions—can be indicated continuously by a device which utilizes the effect of the stream on one float versus the effect on a standard float suspended on an interconnecting arm.

The instrument is shown in partial cross section in Fig. 1. Two float chambers, 1 and 2, attached to the underside of housing 3, provide for comparison float 8 and standard float 12. Chamber 2 contains mercury. The fluid to be measured flows in through inlet 5 to the center of chamber 1, thence out via both port 6 and port 7 simultaneously (so as to counteract the viscous drag on float 8).

The effects of the two fluids—hydrocarbon and mercury—on the floats is transmitted to float arm 10, which is mounted on fixed fulcrum 9 and is provided with adjustable counterweight 30. These varying movements in turn are transmitted through cranks and links, 14, 15, 16, 17, 18, 19, 20, and 22 to pointer 23 and calibrated dial 25.

For closer control of these movements, a temperature compensator is provided. Bulb 34 at inlet 5 affects Bourdon tube 36, which is also connected to the dial and pointer mechanism by link 21. Additional, or substitute, temperature compensation is provided by bath 38 ahead of entrance 5 and surrounding the inlet line for the fluid to be measured.

The unit shown in the figure is designed for fluids in the range of about 0.5 to 1.0 specific gravity. The invention includes units for other ranges. These are provided for by different float arrangements. For example: fulcrum 9 may be located between floats 12 and 8, or in another form, the float positions are reversed, float 8 being nearest and float 12 furthest from the fulcrum 9. The instrument, of course, can be designed for recording or control as well as indicating purposes.

The material of construction can be any metal with satisfactory corrosion resistance to the substance whose specific gravity is to be measured. Float 12 and the guide rod, which are immersed in the mercury, should be of a steel or steel alloy which will withstand amalgamation with the mercury.

U. S. 2,442,039, issued May 25, 1948, to William H. Fortney, Baytown, Texas, assignor to the Standard Oil Development Co.

Maintain Reactor Temperatures By Electrically Induced Heat

HEAT INDUCED by high frequency electrical current can be employed in a reactor for endothermic catalytic conversions such as dehydrogenation, desulfurization, depolymerization, certain types of isomerization, and the like, so as to maintain optimum temperature throughout the catalyst mass.

The method, which utilizes no connections to the heating element within the reactor shell, is said to provide even, easily-controlled heat to the entire catalyst bed, a problem usually encountered when using conventional heating coils through which some heating medium is circulated. The apparatus is shown diagrammatically in partial cross section in Fig. 2.

The primary element of the system consists of coils of pipe 5 and 6, imbedded in the cast refractory lining of the reactor shell. It is constructed of pipe or tubing so that a coolant may be circulated internally for controlling temperatures. Coolant can be water or some non-conductive organic material such as oil or Dowtherm. Non-conducting pipe sections 14 are inserted to prevent the high frequency current from passing into the cooling system.

Current is supplied to the coils by means of a commercially available vacuum tube oscillator. Frequencies range from 200 to 3000 megacycles.

Secondary coil or element com-

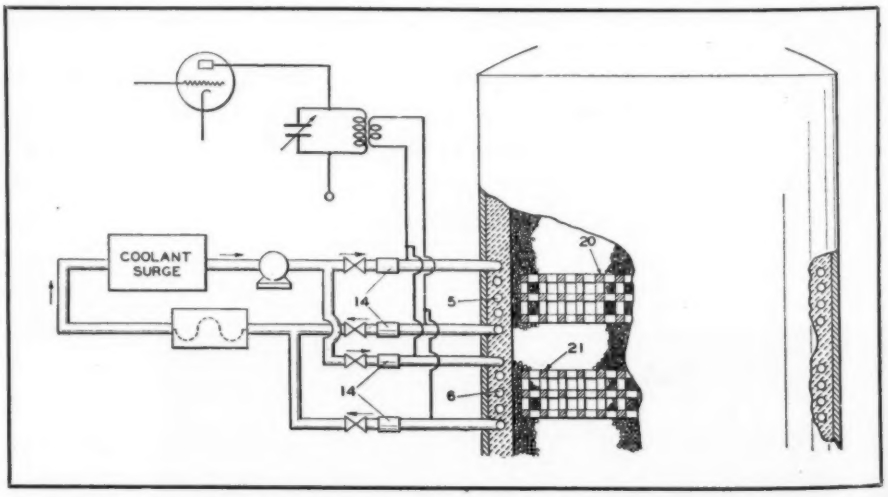


Fig. 2—Checkerworks 20 and 21 form secondary element in method for heating catalyst bed by high frequency current induced heat (U. S. 2,443,428)

INSPECT and CLEAN

"Varec" Extensible Flame Arresters with "Monel" elements

RIGHT ON THE TANK!

Monel* shows high resistance to vapor fumes found where volatile gases are stored.

That's one of the reasons why the "Varec" Entrainment Separator Flame Arrester may be obtained with a Monel element.

But it's not the only reason. "Varec" builds their equipment so you can take it apart easily, get your inspection and cleaning jobs over and done with in a hurry.

Here's how they've fixed things so you can do that—right on the tank. First, you take the cover off the unit. (No trouble there; it's fastened with handy wing nuts.) Then you slide the bank out, like the drawer in a filing cabinet. Inspect both sides of every sheet, clean with a distillate-moistened rag, or a long-bristle brush, or by washing with a prepared solution.

It's as easy as it sounds, for vapor fumes don't make much impression on Monel. Here's a metal that's more than just corrossion-resistant. It is also dense and smooth. And it stays that way. Cleaning is simple—fast—thorough.

Both stronger and tougher than structural steel, Monel is generally a good metal to consider for jobs throughout the refinery. Where operating temperatures are not over 500° F., Monel withstands such commonly-met corrosives as sulfuric acid, caustic soda, salt water and brine – and dilute concentrations of hydrochloric which result from electrolysis of brine in crude.

When you're trying to find a metal that can do a refinery job better—or longer—be sure to think of Monel. Remember its strength and toughness. Remember that it fights corrosion, abrasion and pitting. And if you run into problems involving metal selection, remember also to call on *Inco* for help. Our Technical Service has lots of valuable information on file, and will be glad to advise you—without bias, cost or obligation.

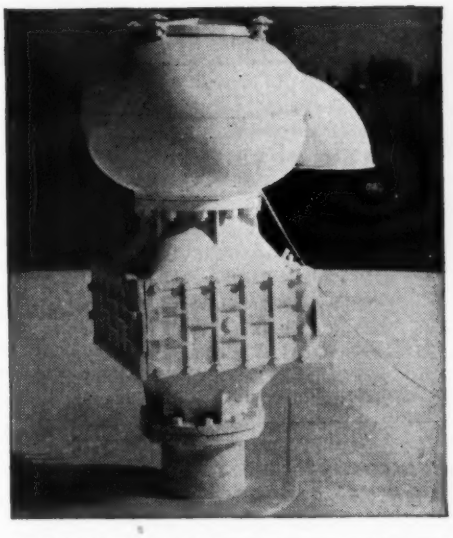
*Reg. U. S. Pat. Off.

For complete information about the "Varec" Entrainment Separator Flame Arrester, write THE VAPOR RECOVERY SYSTEMS COMPANY, Compton, California. Just mention this advertisement and they'll get the full story to you promptly.

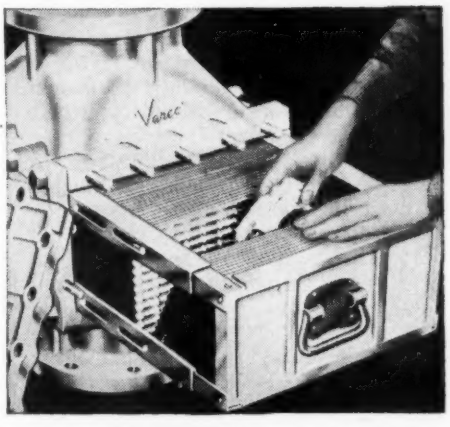
THE INTERNATIONAL NICKEL COMPANY, INC.

67 WALL STREET, NEW YORK 5, N. Y.

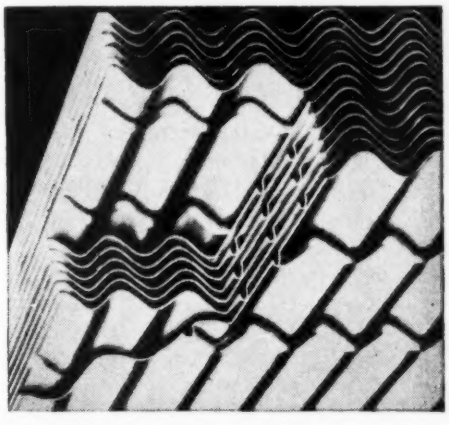
MONEL... YOUR PARTNER IN PROGRESS



USUALLY INSTALLED *between vent valve and tank, upstream of waste gas burners and open vent piping systems, the "Varec" Entrainment Separator Flame Arrester is designed to stop flame or explosion propagation, and to separate and save any liquids entrained in the vapor stream.*



AFTER REMOVING COVER *and pulling out bank, you can easily inspect both sides of every sheet in the multiple-plate, flame-arresting grid. Each sheet is made of Monel, which is highly resistant to vapor fumes. Surfaces are readily cleaned.*



MONEL GRID IN CROSS SECTION. *Net free area through grid is four times corresponding pipe size. Grid design permits greater net free area through each passageway. This helps reduce surface friction, increases flow capacity, gives efficient condensate drainage.* (Photos and operating data courtesy of Vapor Recovery Systems Co., Compton, Cal.)

prises a ferrous metal checkerworks 20 and 21, which can be supported from the top or bottom of the reactor or allowed to float in the catalyst bed. The checkerworks design is such as to provide efficient and uniform transfer of heat to the reactants and still allow efficient flow of catalyst and reacting vapors.

U. S. 2,443,423, issued June 15, 1948, to Carl J. Helmers, assignor to Phillips Petroleum Co., Bartlesville, Okla.

Improve Effects of Quenching With Streamlined Injector

IMPROVED QUENCHING of hot hydrocarbon streams — cracking furnace effluent for example—without deposition of excess coke is possible by an injection fitting designed to reduce turbulence at the quench point to a minimum.

The fitting is designed for quick flange-mounting in the furnace transfer line. It is shown in Fig. 3. Turbulence in the main stream is kept to a minimum by employing a constant diameter conduit, as shown at 16. Flow is from right to left, as indicated by the arrow.

Quenching fluid is admitted via ports 19 and channels 17, passing on to meet the main fluid stream at 20. The angle of channels 17 to the horizontal is made as small as possible while maintaining good mechanical construction for the fitting. This angle, coupled with a flow rate of the quenching fluid as slow as is practical considering the desired cooling effects, reduces turbulence at points 20.

In addition, the quench fluid flows downstream close to the walls of the transfer line, sweeping these walls and preventing deposition of the coke or tarry materials whose precipitation cannot be avoided. Another advantage cited by the inventor for the device over conventional Tee-designed injectors is that the cooling effect is spread over a relatively longer section of the transfer line.

U. S. 2,442,898, issued June 8, 1948, to Bernard G. Maguire, Kansas City, Mo., assignor to Phillips Petroleum Co.

Outlet Valve Removed Quickly By Novel Locking Arrangement

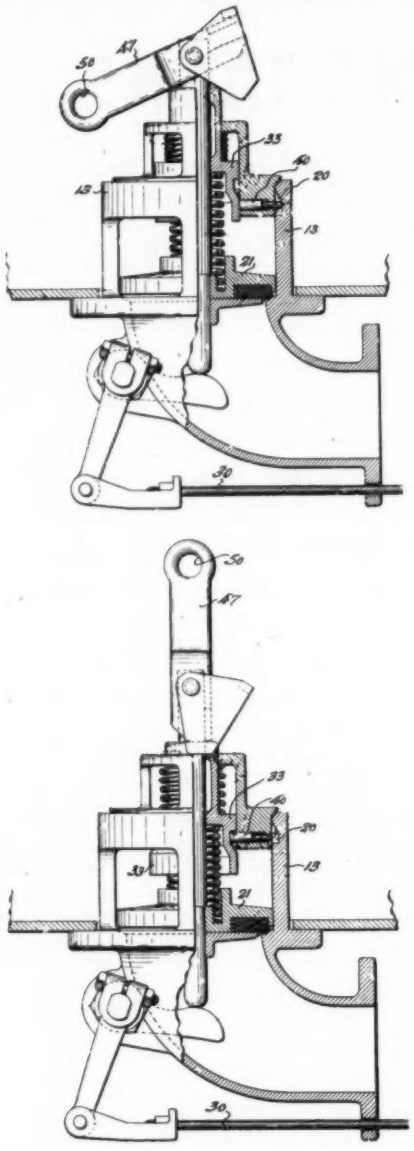


Fig. 4—Above locked position, and below, unlocked position, of a quickly detached emergency valve (U. S. 2,442,953)

A QUICKLY DETACHABLE valve mechanism for use with emergency discharge valves on tank cars or tank trucks is shown to be advantageous should the normal operating mechanism become stuck. It does not require the tank contents to be pumped out the top manhole nor a workman to enter the tank and repair the valve while within the compartment.

The device is illustrated in two views in Fig. 4. Normal operation is provided by a pull on cable 30 which operates through a crank and lever arrangement to push disc 21 upwardly from the seat and open the valve.

In a tank, a connecting line would be fastened to ring 50 and extended through the top manhole. If mechanism 30 becomes inoperable, a pull on this line changes crank arm 47 to a vertical position as indicated in the lower view. This action pushes plunger 33 downward; as a result the lock bolts 40 move inwardly, out of channel 20, and permit the entire

U. S. 2,442,953, issued June 8, 1948, to Howard C. Krone and William Meyer, assignors to Wheaton Brass Works, Newark, N. J.

Other Recent Patents

Space does not permit the complete review of all patents issued recently on equipment for the petroleum processing industry. Following, however, are brief abstracts of those with greatest interest:

Oil-Wax Separator which is especially applicable and designed for the recovery of wax from slack wax. It is a continuous process, said to be self-cleaning and occupying a minimum of plant space. U. S. 2,439,463, issued April 13, 1948, to A. H. Gebauer, assignor to Tide Water Associated Oil Co., Bayonne, N. J.

Fluid Catalytic Cracking erosion is said to be reduced by spraying or quenching the catalyst particles in the hydrocarbon vapor on its way to the separator after leaving the reactor. Preferred as a coating liquid is a low boiling range material such as kerosine, which is easily removed subsequently. U. S. 2,440,591, issued April 27, 1948, to W. K. Lewis, Standard Oil Development Co.

Catalytic Conversion Unit in which provision is made for separating the undersized catalyst particles and returning them to the reaction zone well below the surface of the catalyst bed, employing a vertical screw conveyor which forces such particles into the zone desired. U. S. 2,441,335, issued May 11, 1948, to Edward L. Sinclair, assignor to Socony-Vacuum Oil Co., Inc.

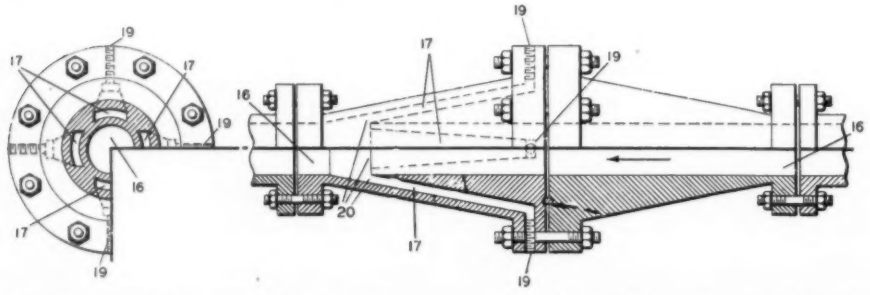


Fig. 3—Quenching fluid channels 17 are as close to parallel as is possible with main conduit 16 in improved injector (U. S. 2,442,898)

FOR MORE INFORMATION—use one of these reply cards to request additional details or literature on any items reviewed in "What's New!" Just circle the numbers corresponding to the items you're interested in, fill in the rest of the card, and drop it in the mail. No postage needed

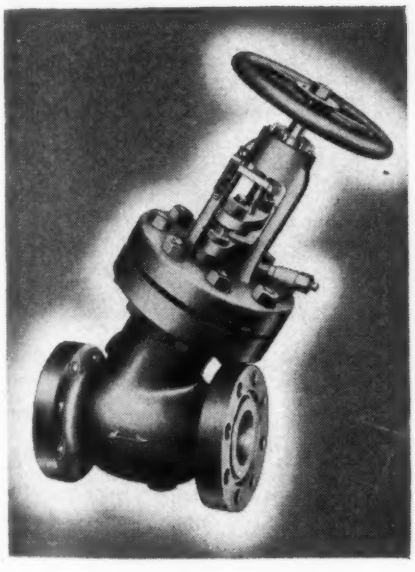
EQUIPMENT
MATERIALS
PROCESSES
LITERATURE

What's New!

Reviewed by WILLIAM C. UHL, Equipment Editor

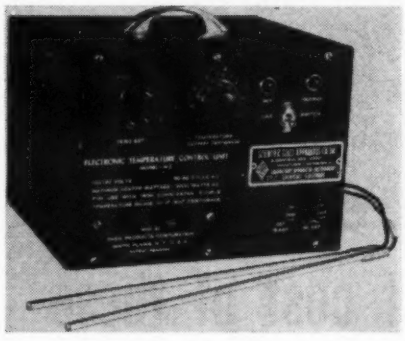
1—Positive Shut-off

Said to give positive shut-off despite corrosion or deposits, a new valve for refinery service is reported to include self-cleaning action, multiple seat design, and injection sealing for emergency conditions. Test records of 500 of these valves in a large oil refinery are said by the manufacturer to prove them satisfactory with low maintenance costs. Valves are available in ½ to 10 in. sizes with choice of standard flange connections. Sellers Injector Corp.



2—Temperature Control

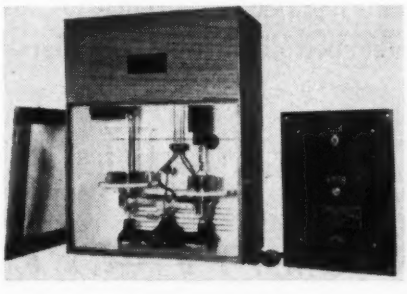
The "Gyco-Phen" Electronic Temperature Control for regulating power flow to electrically-heated laboratory equipment may be preset to reach and maintain desired temperatures within the range of 0 to 500° C. Its rated sensitivity is plus or minus 0.25° C., although external factors may cause a deflection of one or two degrees from selected temperature. Using an iron-constantan thermocouple, the instrument needs no charts or calibrations.



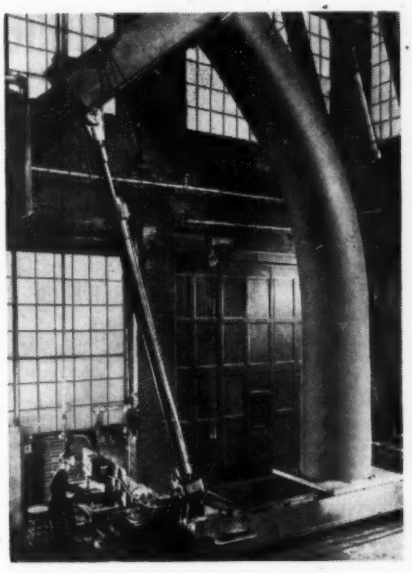
The dial reads directly in degrees C. Inner dial is calibrated in single degrees from 0 to 100, while the outer dial covers 100 degrees for each graduation. Examples of use include ovens, hot plates, water baths, heating jackets, etc. For refrigeration control, a unit with a normally closed relay is also avaiuable. Manufacturer states immediate delivery is assured. Scientific Glass Apparatus Co., Inc.

3—Flow Measurement

The "ERDCO" Automatic Liquid Balance is said to measure flow of any liquid by weight without interruption of flow. Originally intended for measuring fuel flow to internal combustion engines, the balance is equally adaptable to flow measurement of lubricating oils, coolants, alcohols, acids, etc. It may be used in the laboratory for constant use or for special tests. Determinations are independent of physical properties or of temperatures of the liquid; the instrument measures the time required for a given quantity of liquid to flow by balancing against a calibrated weight. The weighing section is in a polished hardwood cabinet with removable glass door. Cabinet is 24 in. high, 18 in. wide, and 9 in. deep. Control unit is in a flush mounting metal housing, with a panel size of 9-1/2 x 13-3/4 in. Engineering Research & Development Co.

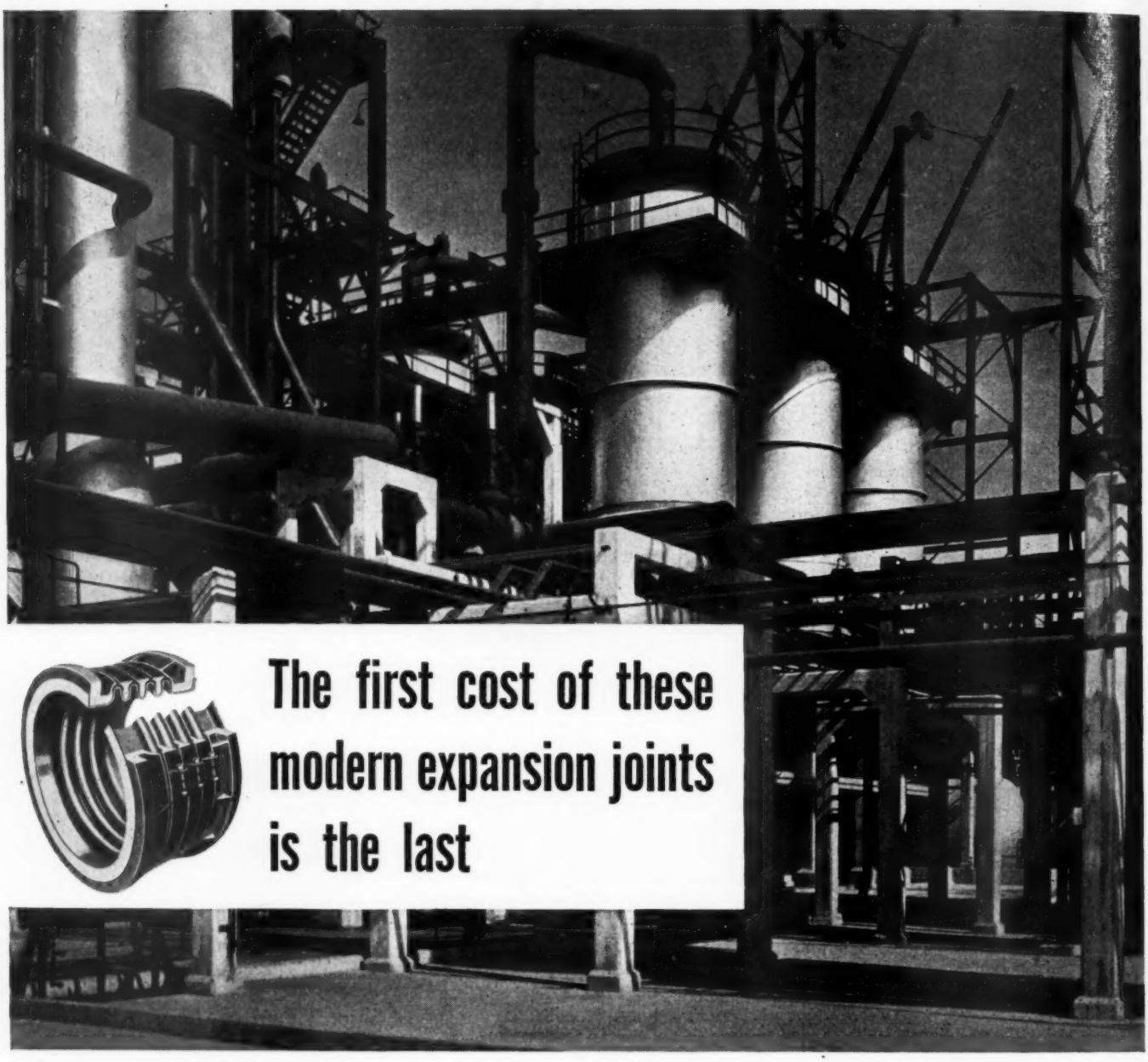


4—Pipe Bender



Bending of large diameter pipe, up to 50 in., has been accomplished in a new pipe bending machine, which engineers state will also handle pipe as large as 100 in. diameter. The method bends pipe in the hot state under hydraulic pressure. It is adaptable to a wide range in pipe diameters, wall thicknesses, and short or long radius bends. Current use for the 50 in. pipe is for carrier lines in large refinery units. Because pipe is bent hot and cooled slowly, stresses remain uniform minimizing possible effects of stress corrosion, it is reported. M. W. Kellogg Co.

More "What's New!" Items, p. 795



The first cost of these modern expansion joints is the last

E. B. Badger & Sons Co. is the original and sole manufacturer of *BADGER* Expansion Joints.

DEPENDABLE Badger Packless Corrugated Expansion Joints are a "lifetime" investment. Once you install them in oil, gas and other lines, your pipe-expansion problems are solved.

Badger Packless Expansion Joints for the Petroleum Industry are compact and easy to install. They require no more space than a flanged fitting. Being made of stainless steel and other alloys, they resist the corrosive effects of the products and processing chemicals handled in oil refineries and other petroleum processing plants.

Furthermore, Badger Joints are scientifically heat-treated during the process of manufacture to remove forming stresses. This heat-treatment assures greater resistance to flexing stresses and longer service life.

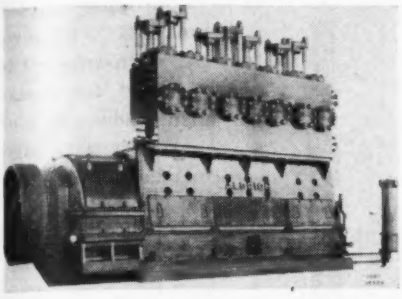
For complete data on these improved expansion joints, write for Bulletin No. 100.

Badger

E. B. BADGER & SONS CO., Cambridge Division, 260 Bent Street, Cambridge 41, Mass.
AGENTS IN PRINCIPAL CITIES

PACKLESS CORRUGATED EXPANSION JOINTS

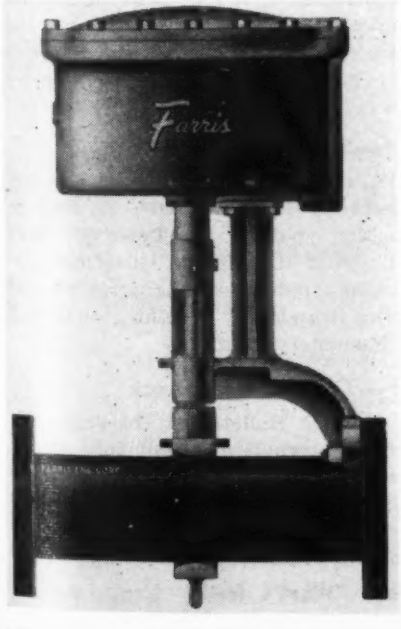
5—Standardized Design



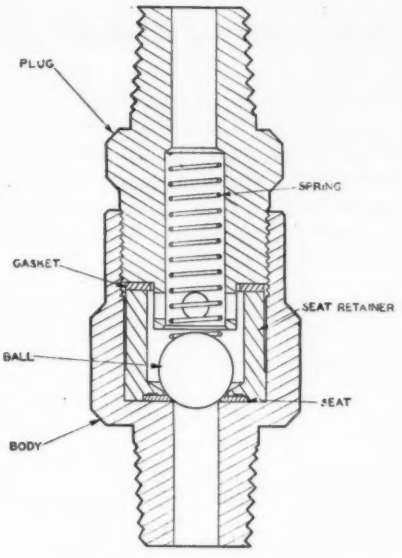
The line of Aldrich Multiplex, high-pressure pumps has been standardized in design to permit use of identical wearing parts such as bearings, crossheads, wristpins, and valves, regardless of plunger diameter and number of plungers. Pump line includes 8 in. in. stroke Triplex, Quintuplex, Septuplex, and Nonuplex; and 7, 7½, and 8 in. stroke Quintuplex, Septuplex, and Nonuplex Pumps, with horsepower ratings ranging from 300 to 2400. If interchangeability of plunger sizes is desired, stuffing box linings can also be provided. Aldrich Pump Co.

6—Pinch Valve Control

A series of automatic controls for use with the recently-announced Farris Pinch Valve have now been made available. The Springless Dual Drive mechanism differs from conventional diaphragm operation in the use of two opposing pistons instead of bulky, large diameter diaphragms. Loading force is maintained throughout entire stroke rather than proportional as in the diaphragm type; this is in keeping with the requirements for control in the Pinch type Valve. Various types of pilot controls are furnished for use with the Springless Dual Drive mechanism. Farris Engineering Corp.



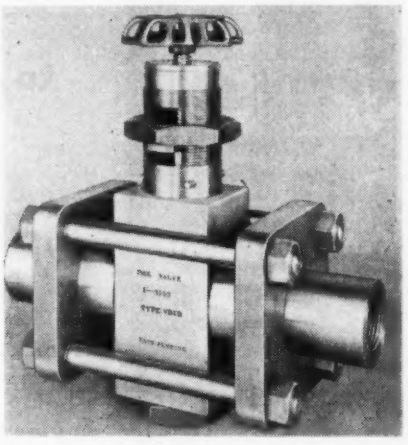
7—Plastic Valve Seat



Use of a soft non-extruding plastic material for seats in check valves results in the ability to withstand high back pressures without danger of seat damage, it is said. The new plastic seats do not tend to fly to pieces under back pressures in excess of 1000 psi.; at the same time satisfactory sealing is provided at low pressure differentials. Present applications are for pump inlet and outlet valves where they are used to prevent flow reversal when passing gases into solution. Valves are precision made of brass, with other metals available on special order. Hoke, Inc.

8—Boiler Blow-down

The new Paul Continuous Blowdown Valve utilizes a venturi ball valve principle to obtain advantages in flow characteristics and resistance to erosion. With two moving parts and no springs, the valve employs the Bernoulli Theorem to force a precision ball into the low-pressure center of the stream, and hence into the seat. The body of the valve is machined to the shape of a venturi tube. The valve tends to close automatically whenever flow occurs. To open the valve, the stem and yoke push the ball down, rolling it out of the seat and down into a recess, so that there is no restriction to straight-line flow. Ball and seats are of Stellite, other parts in high chromium stainless steel. Type VBCB, 1500-lb. series available in sizes from ¼ to 1 in., conforming with inside dimensions of Schedule 80 pipe. Paul Valve Corp.

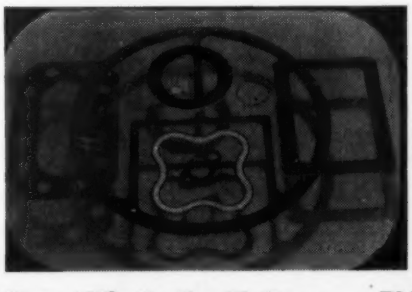


9—Drawing Template

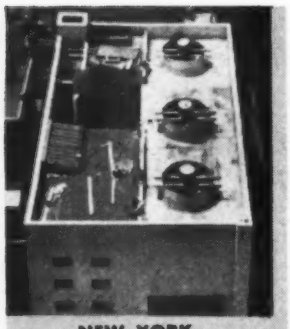
"Flowplanner" Engineering Flow Plan Templates include such standard symbols use in processing industry as vessel heads, nozzles, various types of valves, instruments, pumps and compressors, agitators, exchangers, worms, and furnace coils. Symbols are provided on set of two transparent plastic templates each measuring 0.025 in. thick by 4-3/8 by 6-7/8 in. Timely Products Co.

10—Metallic Gaskets

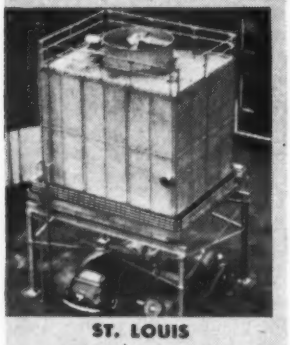
A new line of asbestos-filled metallic gaskets is designed for use in liquid and gas service equipment. Gaskets will withstand temperatures up to 850°F. and pressures up to 1500 psi. They are fabricated of light gage brass, copper, lead, nickel, monel, and other ferrous and nonferrous materials, and filled with soft asbestos. They will be made in any shape or size to meet any specifications. Location of bolt holes is held to within 0.015 in. tolerance. U. S. Gasket & Shim Co.



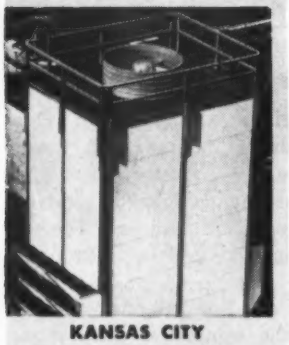
More "What's New!" Items, p. 796



NEW YORK



ST. LOUIS



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Operate Economically and Efficiently

Across the nation, Pritchard has solved the water cooling problems of many air conditioning and refrigeration installations. Broad engineering experience enables us to meet your space limitations and foundation requirements. Our complete line of "fire zone" towers includes:

Steel frame—masonry exterior
Steel frame—steel exterior
Redwood frame—asbestos-cement exterior
Redwood frame—steel exterior

Each is designed for its specific job. Fan drives selected for most efficient application—V-belt drives, right angle speed reducer drives, direct motor-fan drives and the patented Pritchard SEALDFLOW* are all available.

For complete information on cooling towers and other Pritchard services, consult our nearest office or see Sweets Files, ASH & VE Guide, ASRE Data Book and other catalogs.

* SEALDFLOW

Pritchard's patented self-ventilated SEALDFLOW fan drive (as illustrated at right) mounts the motor and gears directly on the fanshaft for highest efficiency and complete protection from corrosive action of saturated vapors. Investigate this time proven, trouble free fan drive! It may be the answer to the mechanical problems on your present tower.

J.F. Pritchard Co.

THREE FUNCTIONS—Engineering, Construction, Manufacturing--
IN FIVE FIELDS—Serving the CHEMICAL, GAS, PETROLEUM and POWER industries as well as providing specialized EQUIPMENT for all industries.

EQUIPMENT DIVISION
908 GRAND AVE. • KANSAS CITY 6, MO.

J.F. Pritchard & Co.
ENGINEERS • CONSTRUCTORS • MANUFACTURERS
for the CHEMICAL • PETROLEUM • GAS and POWER industries

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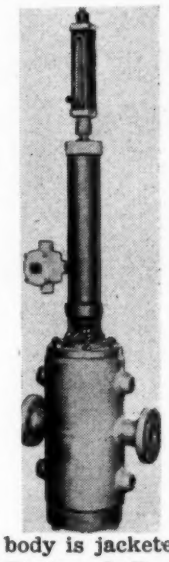
DALLAS • DETROIT • LOS ANGELES • DENVER • ATLANTA • ST. PAUL • SALT LAKE CITY
EL PASO • ERIE • LITTLE ROCK • RICHMOND • OMAHA • MEMPHIS • BALTIMORE
CEDAR RAPIDS • AMARILLO • PHILADELPHIA • NEW ORLEANS

What's New!

11—Molten Solids Meter



The new steam jacketed "Flowrator" instrument is designed for measuring flow rates of materials with high melting points such as molten sulfur, naphthalene, and the like. Remote totalization, recording and control is available as well as indication at the primary element. Meter indicating extension is furnished with steam heating coils and the entire meter body is jacketed for 100 psig. steam. Fischer & Porter Co

12—Adjustable Drum Truck

A new lightweight, general purpose hand truck features two chime hooks, which are adjustable to lock barrels and smaller containers of different heights securely in position. Balance of truck is such that most of the load is carried on the wheels for ease of handling. Trucks are regularly furnished with hollow-center, puncture-proof tires, or with aluminum wheels where acid and oil resistance is needed. General Scientific Equipment Co.

Trade Literature

13—Semi-works Pilot Units

Heat Engineering, Vol. XXIII, No. 2, includes an article on petroleum refining in semi-works pilot units as done in the company's laboratories at Carteret, N. J. Foster Wheeler Corp.

14—Steam Turbines

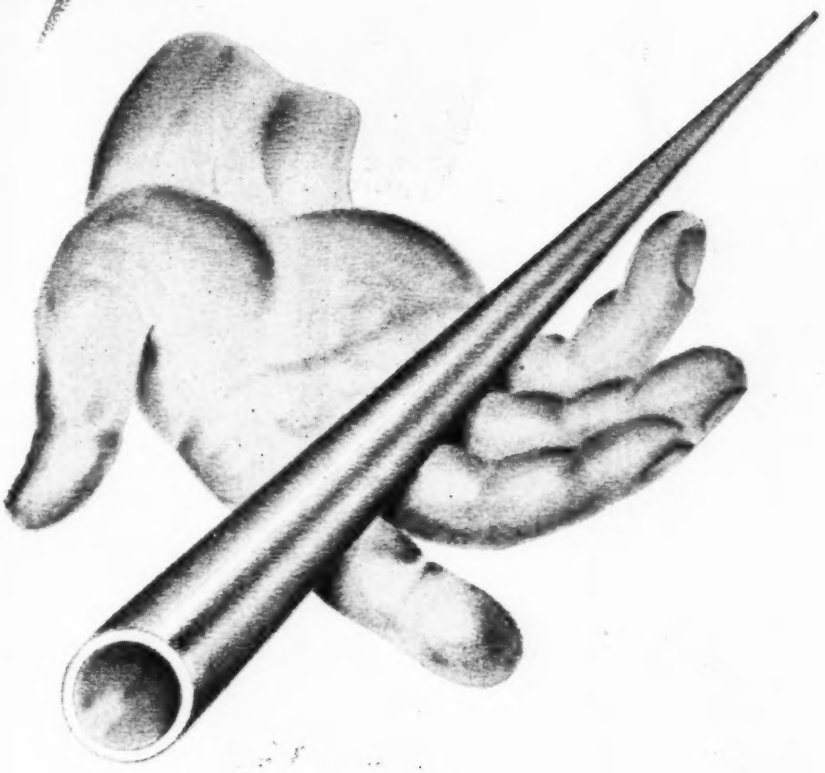
Worthington Multi-stage Steam Turbines, Bulletin 1961, a 24-page booklet covering the Type "S" Turbine with Oil Relay Governor; including application photographs, and detail drawings. Worthington Pump & Machinery Corp.

15—Tube Maintenance

Airetool, Bulletin 41, 20 pages describing complete line of tube cleaners, tube expanders, and oil refinery specialties, giving sizes, and instructions on how to obtain quotations or orders. Airetool Mfg. Co.

More "What's New!" Items, p. 799

HERE'S THE CONDENSER TUBE FOR YOU

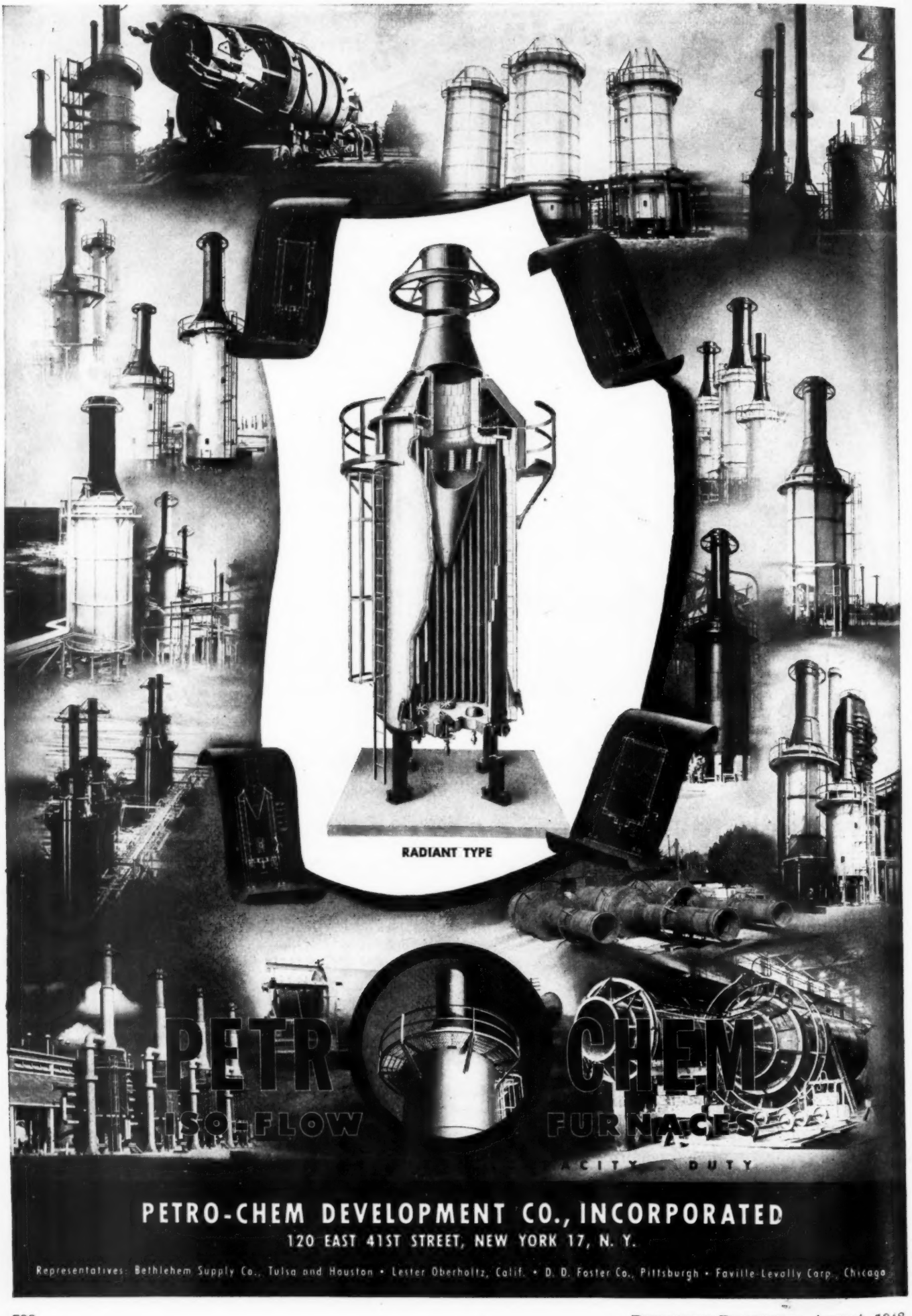


Wolverine seamless, non-ferrous tube—representing QUALITY from the ground up

When we say "from the ground up," we mean that literally. Starting with the virgin copper that emerges from the mines of the renowned copper country of upper Michigan, every step of production is so controlled that the ultimate tube destined for your use will be recognized as the finest example of tube-making craftsmanship—and result in absolute satisfaction in your installation.

You'll be interested in having a copy of our Brochure K8 which gives helpful information about Condenser Tubes.

WOLVERINE TUBE DIVISION
CALUMET AND HECLA CONSOLIDATED COPPER COMPANY
INCORPORATED
MANUFACTURERS OF SEAMLESS NON-FERROUS TUBING
1411 CENTRAL AVENUE • DETROIT 9, MICHIGAN



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120 EAST 41ST STREET, NEW YORK 17, N. Y.

Representatives: Bethlehem Supply Co., Tulsa and Houston • Lester Oberholtz, Calif. • D. D. Foster Co., Pittsburgh • Faville-Levally Corp., Chicago

What's New!

16—Stainless Tubing

Trentweld Stainless Tubes, a 16-page booklet listing stainless steel tubing in sizes from ⅛ to 18 in. diameter and wall thicknesses from 0.007 to 0.187 in., also in Inconel, Monel, and Nickel alloys; includes tables of theoretical weight in lbs. per lineal ft., theoretical bursting pressures in lbs. Trent Tube Mfg. Co.

17—Lubricant Additives

Chemical Additives for Petroleum Lubricants, a 20-page educational booklet explains in non-technical language the "what, why, when, where, and how" of additive compounds for improving lubricants. A number of illustrations aid in describing this complex subject. American Cyanamid Co.

18—Petroleum Equipment

Dresser Industries, Inc., Who We Are, What We Make, How We Operate, is a 48-page, pocket-size booklet listing and describing the products and services of the 13 operating companies in the group, manufacturing such equipment as storage tanks, pumps, compressors, blowers, fittings, valves, and heat exchangers. Dresser Industries, Inc.

19—Inert Gas Generators

How to Make Your Own Inert Gas with Kemp Generators, Bulletin I-10, describes and illustrates the production of inert gases by generators, gives specifications for two series of models and instructions on their use. C. M. Kemp Mfg. Co.

20—Alloy Valves, Fittings

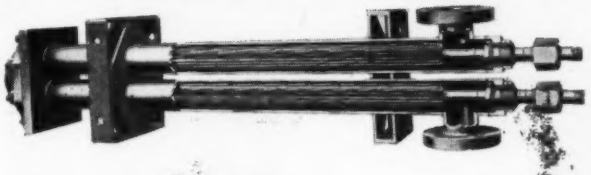
Cooper, Catalog 51M, an 80-page catalog covering line of corrosion resisting Stainless steel valves, fittings, and accessories. A tab-indexing system enables the purchaser to obtain information on prices, dimensions, finished weights, etc. Cooper Alloy Foundry Co.

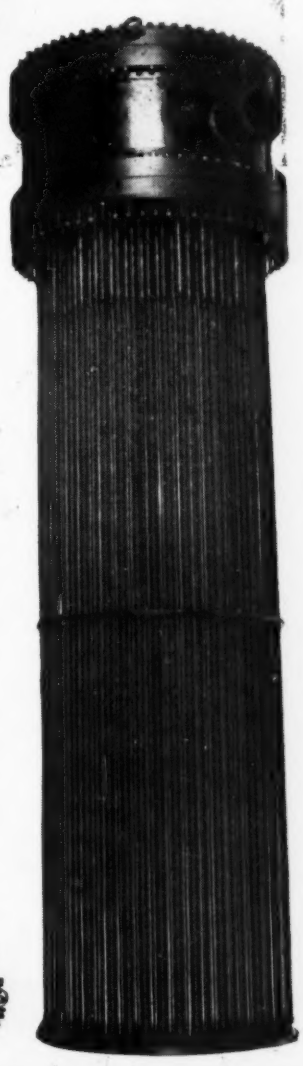
21—Alloy Tubing

Properties of Carbon and Alloy Seamless Steel Tubing for High Temperature and High Pressure Service, Technical Bulletin No. 6-E, is a special 145 page booklet giving complete engineering specifications, test result data, and an explanation of failures. Readers desiring copies are requested to write on company letterhead direct to Babcock & Wilcox Tube Co., Beaver Falls, Penna.

More "What's New!" Items, p. 801

Why G-FIN is widely adaptable to many kinds of SERVICES • FLUIDS • UNITS





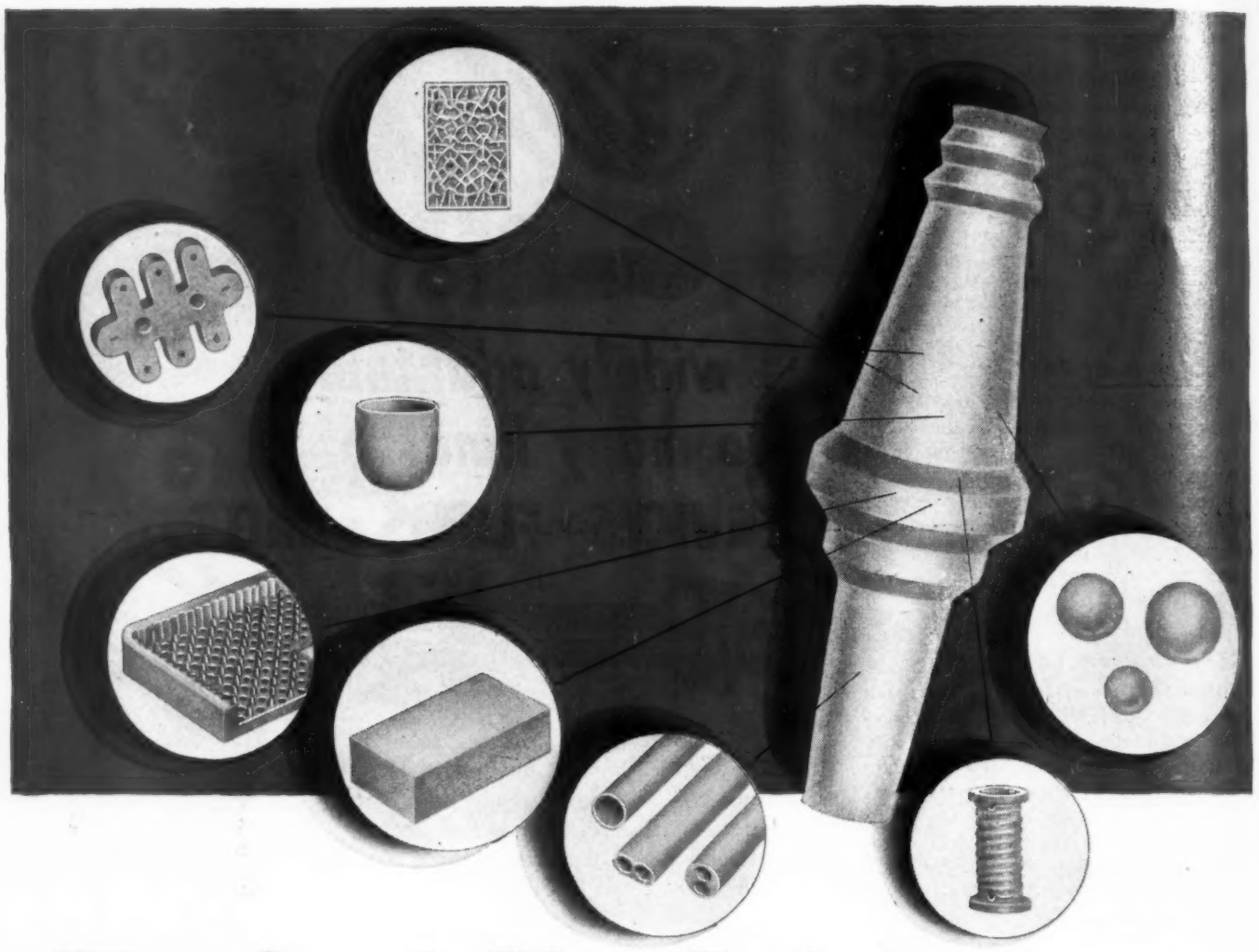
The G-FIN Element, originated 15 years ago by Griscom-Russell, has demonstrated the greatest range of usefulness of any heat transfer surface on the market.

These elements are used in more than 40,000 Twin G-Fin Sections serving as heaters, coolers, condensers and heat exchangers for a wide variety of liquids, vapors and gases. They are also extensively used in tank heaters, contactor bundles, and baffled units.

One reason for this unequalled adaptability of the G-Fin element is its longitudinal fins which provide six to eight times the external heat transfer surface of a bare tube. Another reason is that these elements can be applied to standard interchangeable sections which can be used for many different services. G-Fin elements have fully proven their dependability over long periods of service and under severe operating conditions.

THE GRISCOM-RUSSELL CO.,
285 Madison Avenue, New York 17, N. Y.

GRISCOM-RUSSELL
Pioneers in Heat Transfer Apparatus



This Spark Plug Body holds a lot of profitable ideas—

—Ideas for users and manufacturers of high-temperature refractory brick . . . electrical insulators . . . burner tips . . . grinding balls . . . heat transfer pebbles . . . combustion and thermocouple tubes . . . and linings for furnaces, kilns and towers.

—Ideas for those who need a material that holds dimensions accurately, yet resists extremely high thermal, mechanical and dielectric stresses.

Most spark plug bodies today are more than 90% ALCOA Tabular Alumina, because this material offers a unique combination of properties. It is a dense refractory in the form of corundum with:

Low water absorption: 1% to 4%

Low porosity: 3% to 13.5%

High fusion point: 2050 C. or 3722 F.

High properties in a sintered alumina body—

***Tensile Strength: Up to 36,000 lb./sq. inch**

***Compressive Strength: Up to 410,000 lb./sq. inch**

***Dielectric Strength: Up to 1100 volts/mil.**

ALCOA Tabular Alumina is *preshrunk*. This means that it holds dimensions extremely well during firing—a property that often entirely eliminates the necessity of finish-grinding or machining.

ALCOA Tabular Alumina is available as coarse granules or fine powder. Let us tell you more about this interesting form of aluminum oxide. Write to ALUMINUM COMPANY OF AMERICA, CHEMICALS DIVISION, 1780 Gulf Building, Pittsburgh 19, Pennsylvania.

** From "Westinghouse Engineer," May, 1946*

ALCOA CHEMICALS

ALUMINAS AND FLUORIDES

ACTIVATED ALUMINAS • CALCINED ALUMINAS • LOW SODA ALUMINAS • TABULAR ALUMINAS • HYDRATED ALUMINAS

ALUMINUM FLUORIDE • SODIUM FLUORIDE • SODIUM ACID FLUORIDE • FLUOBORIC ACID • CRYOLITE

What's New!

22—Radioactive Chemicals

Tracerlog, No. 11, June, 1948, describes a series of packaged radiochemical compounds tagged with Carbon-14, and also includes an article on the administration and operation of a radiochemical laboratory. Tracerlab, Inc.

23—Tube Expanders

Wiedeke, Bulletin No. 61, gives dimensions, ranges, and prices on line of adjustable tube expanders for rolling small tubes in thin, thick, or multiple tube sheets. Gustav Wiedeke Co.

24—Metal Inspection

Supersonic Reflectoscope, Bulletin 3001, describes operation and application of a new instrument for nondestructive testing of weld and other metals, the Type SRO5 Supersonic Reflectoscope. Sperry Products, Inc.

25—Cathode-Ray Apparatus

Du Mont Cathode Ray Equipment, Form 760, a 12-page bulletin covering the tools used in present-day oscillography—cathode ray tubes, oscillographs, and accessories, giving specifications, sizes, power requirements, and the like. Allen B. Du Mont Laboratories, Inc.

26—Flue Gas Analysis

Davis Continuous Indicating and Recording Flue Gas Analyzer, Bulletin No. 1136A, covers a new instrument for analysis of flue gas on oil, coal, and gas fired boilers. Davis Emergency Equipment Co.

27—Tank & Line Heaters

Brown Fintube Tank Suction Heaters and Line Heaters, Bulletin 482, includes drawings, dimensions, and capacities of a line of heaters for tanks or lines, designed to facilitate movement of viscous oils. Brown Fintube Co.

For Your Convenience

Business reply cards are included in this issue of PETROLEUM PROCESSING to assist you in obtaining more information on any items reviewed in "What's New!" You'll find them facing page 793. Just circle the numbers corresponding to the numbers on the items you're interested in, fill in the bottom of the card, and drop it in the mail. No postage required.

DURA PLASTIC Packings

USERS everywhere are testifying to the outstanding service performed by this general purpose semi-metallic packing. DURA PLASTIC provides improved sealing for gasoline — water — air — steam — oils and chemicals . . .

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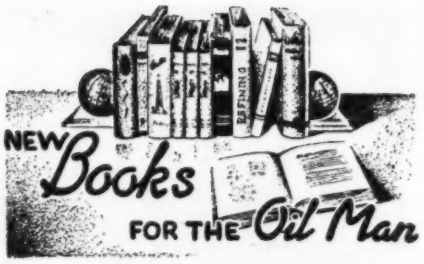

Mines Bureau Crude Oil Report First of its Type since 1928

Analysis of Crude Oils from 283 Important Oil Fields in the United States, R. I. 4289, by C. M. McKinney and O. C. Blade, U. S. Bureau of Mines, 8 x 10½ in., 154 pages.

This Report of Investigations by the Interior Department's Mines Bureau represents the first complete report since 1928 showing analyses of crude petroleum from fields throughout the U. S., although a number of separate reports according to area or State have been issued. Many of these are now out of print.

It gives detailed analyses from most of the fields producing 2500 b/d or more. On January 1, 1947, there were 340 fields of that size; the report covers 283 of these fields. Fifty-seven fields have been omitted because the Mines Bureau did not have analyses of the crudes being produced. All analyses were made by the Bureau's routine method which has been used in the same essential particulars for over 25 years.

No index is provided, but the data are given in alphabetical order by State, and by field in each State. Authors McKinney and Blade are chemical engineer and petroleum chemist, respectively, with the Mines Bureau's Petroleum Experiment Station at Bartlesville, Okla.

Readers may obtain the book free of charge direct from the Bureau of Mines, Publications Section, 4800 Forbes St., Pittsburgh 13, Penna.

Copies of all books reviewed here may be ordered from the Reader's Service Department, Petroleum Processing, 1213 West Third St., Cleveland 13, for the price listed, postpaid, unless indicated otherwise. Ohio purchasers please add 3% tax. U. S. Government publications should be ordered direct from the Superintendent of Documents, Washington, D. C.

Translate and Publish Study by Germans on Engine Lubrication

Wear and Lubrication of Piston Rings and Cylinders, by Dr. Reemt Poppinga; 5¼ x 8¼ in., 201 pages, indexed, stiff cloth binding, published by the American Society of Lubricating Engineers, $3.00 to members, $3.50 to non-members.

Originally published by the Society of German Engineers, Inc., in Berlin in 1942, *Wear and Lubrication of Piston Rings and Cylinders* has now been translated from the German and published by the ASLE through arrangement with the Office of Alien Property of the Department of Justice.

The book covers much of the work done in Germany as well as other European nations in this particular field, but concerns itself primarily with work under the sponsorship of the Institute for Motor Transport of the Technical University of Dresden and also by the Reich Ministry of Transport. For that reason it should be of considerable interest to lubrication engineers in this country.

The work described covers investigation of three major factors: the effect of material structure, the influence of the lubricant, and the influence of engine operating conditions, upon wear. As to suitable methods for appraisal of oils for motor lubrication, it is interesting to note that the Germans agree generally with engineers throughout the world that no satisfactory laboratory tests have as yet been developed as good substitutes for actual testing of lubricants in engines under variably controlled operating conditions.

The book was translated from Dr. Poppinga's original text by Dr. Edmund Kurz of Queens College, Flushing, N. Y. Dudley D. Fuller of Columbia University served as technical adviser. It was produced by the photo-offset method of printing from typewritten copy and is on the whole a good job, clearly reproduced and easily read. In an extensive bibliography, the listings are given in the language in which they were originally published, either German or English.

Standards Compiled on Paint, Varnish, and Related Products

ASTM Standards on Paint, Varnish, Lacquer, and Related Products, prepared by Committee D-1; 6 x 9 in., 565 pages, heavy paper binding, illustrated, $4.35 (December, 1947).

Both as users of paint products and as suppliers of some paint manufacturing raw materials, petroleum technologists will find the latest compilation of *ASTM Standards on Paint, Varnish, Lacquer, and Related Products* of value.

Standards — tentative, proposed, and adopted—are given for pigments, drying oils, paint driers, thinners, shellac, varnish, varnish materials, lacquer and lacquer materials, traffic paint, general paint tests, paint weathering tests, putty, naval stores, and miscellaneous classifications.

MEETINGS . . . for the Oil Man

AUGUST

18-20, Society of Automotive Engineers, West Coast meeting, St. Francis Hotel, San Francisco.

30-Sept. 3, American Chemical Society, 114th national meeting, Eastern session, Washington, D. C.

SEPTEMBER

6-10, American Chemical Society, 114th national meeting, Midwest session, Jefferson Hotel, St. Louis, Mo. (NOTE—this session of the 114th national meeting will include meetings of the Petroleum Chemistry Division.)

13-17, Third Instrument Conference and Exhibit, Convention Hall, Philadelphia.

13-17, American Assn. for the Advancement of Science, centennial meeting, Washington, D. C.

13-17, American Chemical Society, 114th national meeting, Western session, Portland, Ore.

15-17, National Petroleum Assn., Hotel Traymore, Atlantic City, N. J.

15-17, American Institute of Chemical Engineers, regional meeting, French Lick Springs, Ind.

20-22, National Butane-Propane Assn., Chicago.

27-28, Independent Petroleum Assn. of America, Plaza Hotel, San Antonio, Texas.

27-Oct. 1, National Plastics Exposition, Grand Central Palace, New York.

OCTOBER

4-9, American Gas Assn., annual convention, technical section, Ambassador Hotel, Los Angeles.

8, California Natural Gas Assn., 23rd annual fall meeting, Ambassador Hotel, Los Angeles.

11-13, National Lubricating Grease Institute, 16th annual convention, Edgewater Beach Hotel, Chicago.

12-16, National Chemical Exposition, Coliseum, Chicago.

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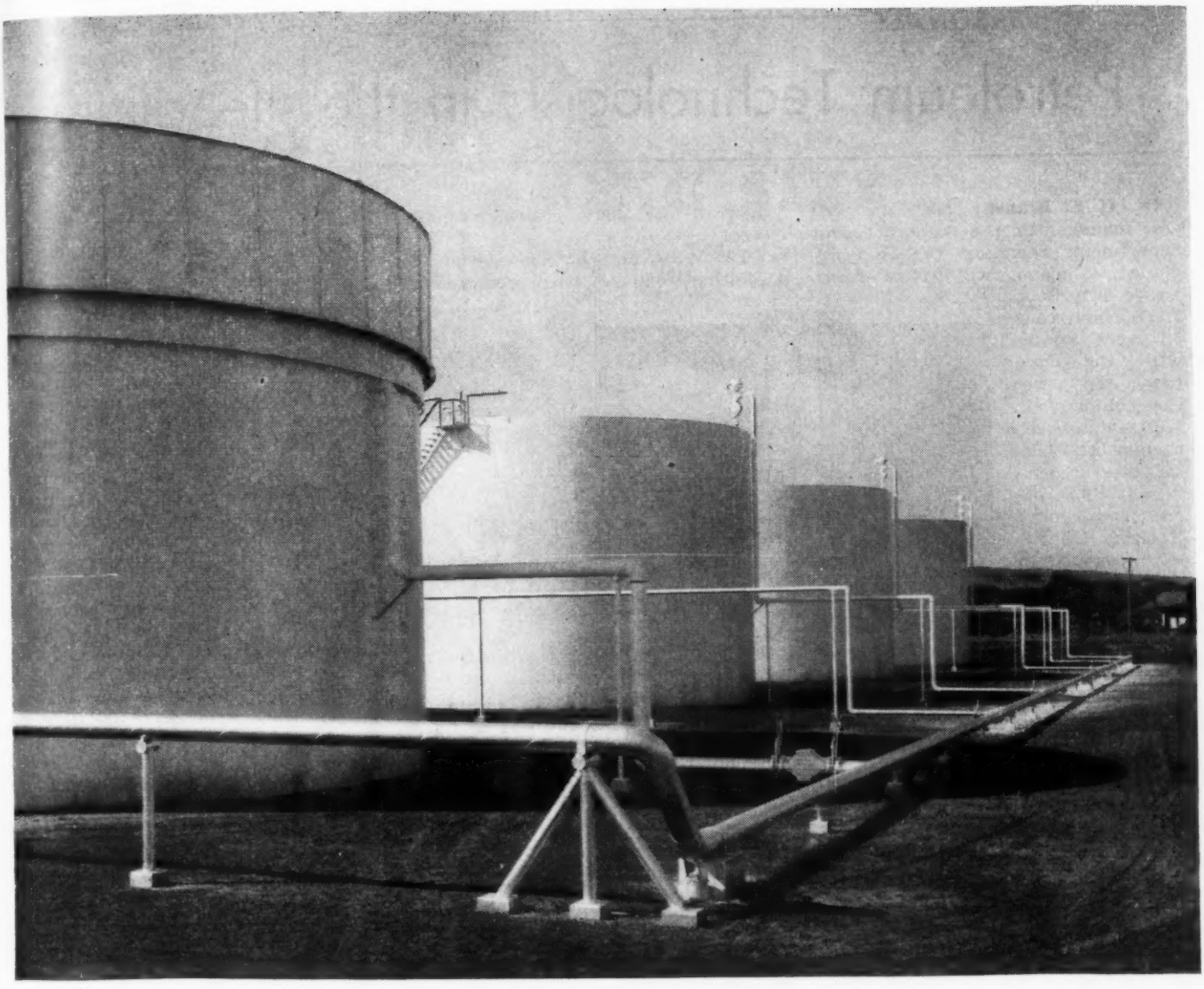

PARTY LINE—REFINERY STYLE

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A closed system is formed with a single Expansion Roof tank and as many as eight cone roof tanks using the manifold line. As vapors expand due to rises in temperature or as they are displaced during filling operations, they travel through the manifold line into the vapor space of the Expansion Roof. The roof rises to accommodate these vapors and venting to the atmosphere is prevented.

When temperatures drop or pumping out takes place, the vapors travel back to the vapor spaces of the various tanks and the roof descends. There is no breathing in of moisture laden air.

For details on applying the "party line" system to your petroleum storage facilities, write today.

FABRICATED PLATE DIVISION

GRAVER TANK & MFG. CO., INC.

East Chicago, Indiana

Graver offers a complete service to the petroleum industry including Expansion Roof Tanks, Floating Roof Tanks and pressure vessels. In addition, Graver is prepared to furnish specialized steel plate work such as fractionating columns and class one vessels as well as stainless and alloy fabrication; water conditioning equipment of all types; and through its General Construction Division is prepared to handle all types of installation and erection work.

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PERSONALS

Petroleum Technologists in the Headlines

Dr. C. E. Bransky, assistant general manager of the manufacturing department, Standard Oil Co. (Indiana), Chicago, will retire from active duty Sept. 1 after more than 38 years' service with the company. He joined the company in 1910 as research chemist at Whiting after receiving his Ph.D. degree from Johns Hopkins University. After four years in the chemical laboratory, he became assistant superintendent of the paraffine department, and later superintendent. In 1931 he was promoted to manager of the Whiting refinery and in 1934 transferred to Chicago as assistant general manager of the manufacturing department.

Dr. Bransky

Dr. W. J. McGill, manager of the Whiting refinery, was promoted to the new position of superintendent, manufacturing operations, in the Chicago office, in a reorganization of the manufacturing department in the general offices. He is an alumnus of University of Michigan and joined the company in 1924 as chemist at Whiting. In 1928 he was transferred to the Wood River, Ill., plant as lubricating works assistant and became respectively general foreman of the lubricating works, assistant general superintendent, general superintendent and manager in 1942. He was transferred to Whiting as manager in 1946.

Dr. McGill

Mr. Ducommun

J. C. Ducommun has been promoted to manager at the Whiting refinery of Standard Oil Co. (Indiana), succeeding Dr. McGill. An alumnus of the University of Iowa, he joined the company in 1929 in its engineering department at Whiting. He organized the engineering inspection department in 1932, in 1934 became assistant general foreman of the pressure still department and three years later general foreman of that department. He became assistant superintendent of the light oils division in 1943 and assistant general superintendent of the Whiting refinery in 1944.

* * *

L. L. Davis is manager of Continental Oil Co.'s newly created development and research department at Ponca City, Okla. He will coordinate this type of activities from all departments of the company. Prior to his present appointment he was supervisor of technical services of the manufacturing department.

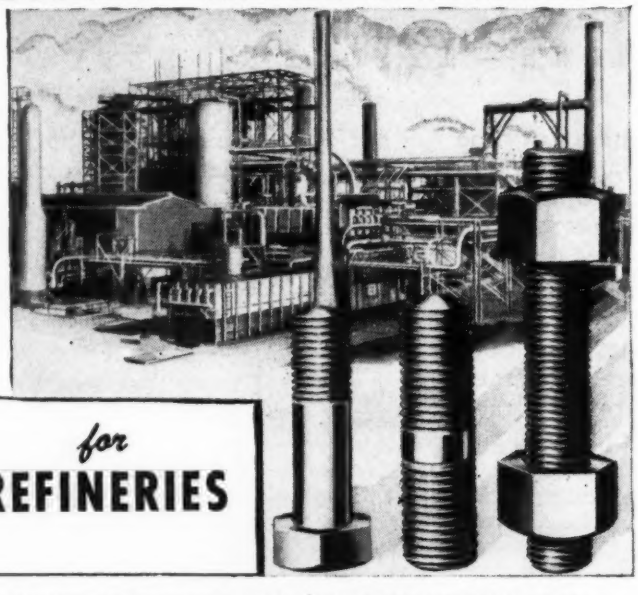
Mr. Davis

Born in Kansas, Mr. Davis moved as a boy to Bellingham, Wash., and received his M.S. degree in chemical engineering from the University of Washington in 1917. His first job in the petroleum industry was with Crew-Levick Co., a Cities Service subsidiary, as trainee in refinery operations at Warren, Pa. In 1918 he was transferred to Tulsa as technical assistant to the general superintendent in charge of Cities Service refineries in the Mid-Continent.

In 1921 he went with Pierce Oil Corp., a Sinclair subsidiary, as technical assistant to the manager of manufacturing. He established a laboratory for the company at Sand Springs, Okla., one of the first in the southwest for petroleum research and development. He joined Con-

ERIE SPECIAL BOLTING FOR HEAVY MACHINERY

FOR over 30 years ERIE has specialized in the manufacture of *high quality bolting*. We use the very latest equipment for heat treating, machining, grinding and threading. We are certain that we can produce better bolting at a saving to you because we are specialists — send us your bolting specification for our estimate.



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SUBSIDIARY OF BARIUM STEEL CORPORATION
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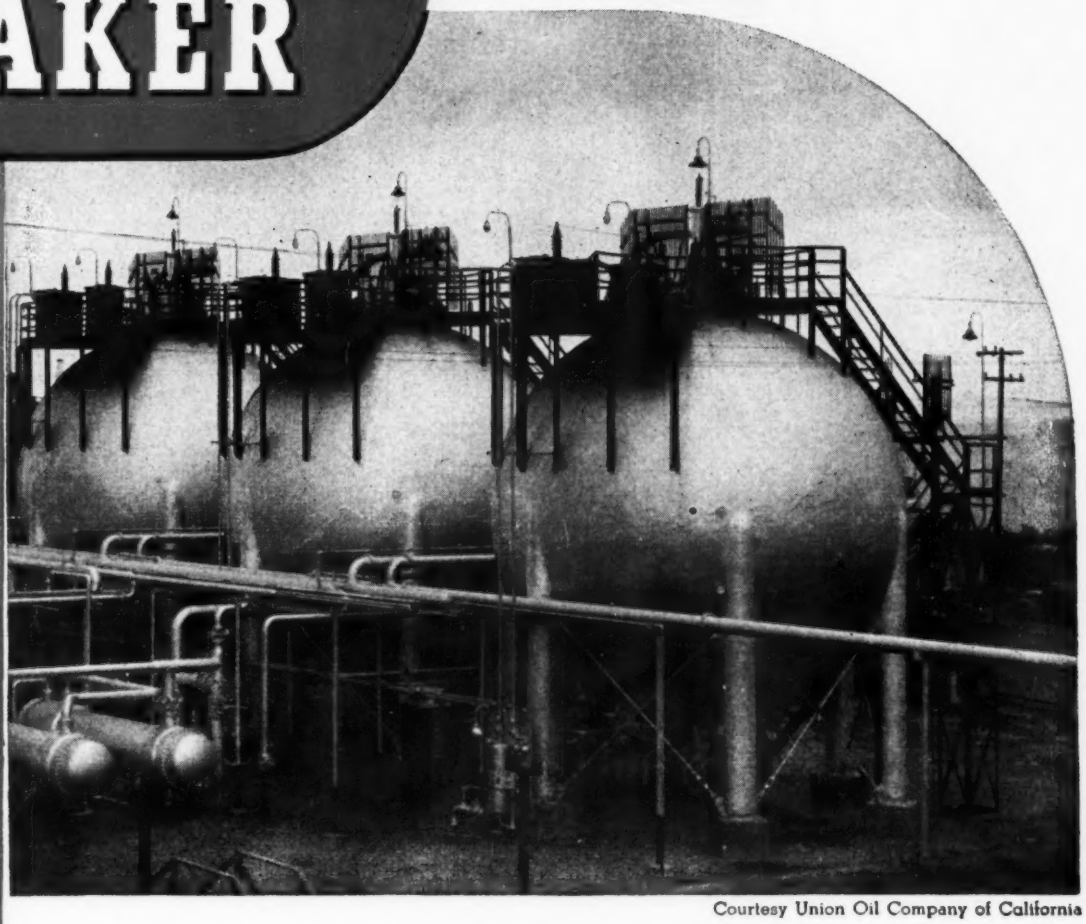
STUDS • BOLTS • NUTS ~ ~ ALLOYS • STAINLESS • CARBON • BRONZE

SALT SHAKER KING SIZE...



Courtesy Union Oil Company of California

A Petreco Electric Desalter doesn't exactly *shake* out the salt, but it sure gets rid of it–right now. Most Petreco desalters are getting 90% or better removal–98, 99 and 100% removal efficiencies are not unusual. Desalting eliminates the nuisance of frequent refining shut downs caused by salt plugging, hard coking and HCl corrosion. Desalting insures greater capacity, longer runs, and smoother operations. If you're having any salt difficulties, get in touch with us. We've helped some mighty good refining men shake the salt problem out of their hair. *The Petreco process is not expensive;* a Texas refiner recently figured his Petreco desalter paid off in less than six months. Get in touch with a Petreco engineer–he'll show you the figures!

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530 West Sixth Street, Los Angeles 14, Calif.

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STRONG* 70 Series Traps
give better service!

Look to these five reasons for long, trouble-free service in STRONG 70 Series Traps:

1. *Valve and seat guaranteed leakproof for one year—made of STRONG's patented, wear-resistant Anum-Metl;*
2. *Easy servicing—permitted by the renewable seat design, cover with all working parts easily removed without breaking pipe connections;*
3. *One piece bucket—stainless steel, no welds;*
4. *Turbulence avoided, choking minimized, 25% greater capacity—with STRONG's exclusive Hi-Cap orifice;*
5. *No dribbling, quick, full opening—high ratio leverage.*

STRONG *in-line* 70 Series Traps are available in sizes from ½" to 1", semi-steel construction. STRONG's "two-in-one" blast trap with integral thermal air vent is also available in the 70 Series (see cut below).

Catalog No. 67 describes these traps in detail along with other STRONG traps. Write today.

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STRONG

Personals

tinental Oil Co. in 1927 as technician and assistant superintendent of the Ponca City refinery. He became acting general superintendent in 1928, was promoted to supervisor of the process division in 1929 and has since been supervisor of technical services of the manufacturing department.

One of Mr. Davis' first assignments with Continental was to organize a process laboratory and from that has grown the present system of 9 laboratories which are to be expanded in the program of the new research and development department.

* * *

Dr. John Happel, chemical engineer with Socony-Vacuum Oil Co., Inc., has joined the Chemical Engineering Department staff of New York University's College of Engineering as Professor of Chemical Engineering. His new duties will begin Sept. 1.

Dr. Happel

He received his B.S. degree and his M.S. in Chemical Engineering Practice at Massachusetts Institute of Technology and this June received his Dr. of Ch.E. degree at Polytechnic Institute of Brooklyn. He organized and taught graduate courses at the latter institution. His entire 16 years of industrial experience has been with Socony-Vacuum, first at their Brooklyn laboratories. During the war he served on the Technical Advisory Committee of the Petroleum Industry War Council and later was a member of the Neches Technical Committee, which handled the design and initial operation features of the huge butadiene plant at Port Neches.

* * *

James J. Donnelly, Paulsboro, N. J., and **F. A. Angona,** Dallas, are recipients of fellowships awarded by Socony-Vacuum Oil Co., Inc., and will receive leaves of absence from the company's laboratories with full pay to study for their doctor's degrees.

Mr. Donnelly, a native of Philadelphia, graduated from Villanova in 1943, and has been in the Paulsboro Research and Development Laboratories for over two years and was previously in the Navy. He plans to attend the University of Delaware to study the fundamentals of combustion.

Mr. Angona graduated in 1942 from the University of California at Los Angeles, majoring in physics. He has been with the Field Research Laboratories of Magnolia Petroleum Co., a Socony-Vacuum affiliate for two years and was previously in the

Navy. He plans to study mechanics and hydrodynamics as related to oil production at the California Institute of Technology.

* * *

Roy J. Diwoky has been made assistant general superintendent of the Whiting refinery of Standard Oil Co. (Indiana). A native of Iowa he received his B.S. and M.S. degrees in chemical engineering at the University of Iowa. He joined the Indiana Standard in 1935 as member of the technical service staff of the research department at Whiting, where he became group leader in 1939.

Mr. Diwoky

In 1940 Mr. Diwoky was transferred to the manufacturing department at Whiting as assistant general foreman of pressure stills in the light oils division. He became technical assistant to the executive manufacturing staff in the general offices in Chicago in 1943, assistant superintendent of the light oils division at Whiting in 1945 and in 1947 was appointed superintendent of the Whiting projects division.

Dr. R. F. Faull has been named to the newly-created position of manager of the La Habra, Cal., oil field research laboratory of California Research Corp., subsidiary of Standard of California. The company's two oil field research units, at Whittier and La Habra, are being combined into one organization, with headquarters at La Habra.

Dr. Faull

Dr. Faull holds B.S. and Ph.D. degrees in chemistry from the University of California and joined Standard in 1937 in its research and development department, the predecessor of California Research Corp. His most recent position, to which he was appointed in 1945, was supervisor of the refinery technology and technical service division at the Richmond Laboratories of the research subsidiary.

Assisting Dr. Faull in his new work will be **Walter C. Dayhuff,** technical assistant in charge of administrative functions and surface processing research, and **Dr. M. B. Standing,** division supervisor in charge of research on drilling and production.

CLASSIFIED

Situations Open

WANTED: Draftsmen with experience, preferably in oil refining. Age 20-40. Good salary. Opportunities for advancement. Write, stating qualifications, to Mr. E. G. Glass, Jr., The Standard Oil Company (Ohio), 1780 Midland Building, Cleveland 15, Ohio.

WANTED: Piping designers with 5-10 years' experience, preferably in oil refining. Age 25-40. Salary over $5,000 per year. Opportunities for advancement. Write, stating qualifications, to Mr. E. G. Glass, Jr., The Standard Oil Company (Ohio), 1780 Midland Building, Cleveland 15, Ohio.

POSITIONS OPEN

Large independent oil company has a number of desirable openings in its Refining Division for qualified individuals of five to fifteen years experience in refining field as follows:

1. Supervision—thermal and catalytic cracking
2. Supervision—modern lube oil refinery, propane, M.E.K., phenol
3. Supervision — general refinery maintenance
4. Equipment Inspectors

Applicant please supply resume of experience, photo and expected salary in initial reply.

BOX NO. 23

Classified Rates

"For Sale," "Wanted to Buy," "Help Wanted," "Business Opportunities," "Miscellaneous" classifications, set in type this size without border—20 cents a word. Minimum charge, $5.00 per insertion.

"Position Wanted"—10 cents a word. Minimum charge $2.00 per insertion.

Advertisements set in special type or with border—$7.00 per column inch.

All classified advertisements are payable in advance.

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American Cyanamid Co. 718
American Petroleum Institute 747
Babcock & Wilcox Co. and/or Tube Co. 764
Badger & Sons Co., E. B. 784-785-794
Calumet & Hecla Consolidated Copper Co. ...
Carrier Corp. 763
Chicago Bridge & Iron Co. 783
Cooper Alloy Foundry Co., The 757
Crane Co., The 754
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DuPont deNemours & Co., Inc., E. I. facing pg. 760
Durametallic Corp. 801
Enjay Co., Inc. 745
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Shell Oil Co., Inc. 786
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Solvay Sales Division of Allied Chemical & Dye Corp. 789
Strong, Carlisle & Hammond Co. 806
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Warren Petroleum Corp. 728
Wolverine Tube Divn. 797
Wyatt Metal & Boiler Works ..Outside Back Cover

EDITORIAL VIEWPOINTS...

Opinions and Comments on Current Topics

95% Operating Performance Means Urgent Need for New Plant Steel

THE HIGH OPERATING RATE consistently maintained in U. S. refineries, as high in some weeks as 95% of crude charging capacity, is a tribute to the resourcefulness and ingenuity of the plant staffs and crews. At the same time it carries its own message to the effect that the refining industry's plant construction program should be expedited by all means possible, if further increases in product demand are to be met.

The nation's refineries have been run for two years at 90% and better of crude charging capacity, as compared with 85% in the immediate postwar period and an even lower rate in the prewar period. In recent weeks the rate has been even higher. The practical effect has been the same as adding new plant capacity. For example, crude runs to stills for the first four months of 1948 were at the average rate of 5,407,000 b/d. This was 630,000 b/d more crude run than for the same period in 1947; it was an increase of nearly 700,000 b/d from average runs for all of 1945. Even more impressive, it is an increase of 1,547,000 b/d in crude charged to stills since the last prewar year, 1941.

This high operating rate the refineries have maintained has made it possible for the industry to supply the increased volumes of gasoline and distillate fuel products so sorely needed over the past year.

This additional crude charge capacity has been secured to only a very small extent by building new crude distillation units. Mostly it has been gained by eliminating plant bottlenecks, using obsolete units, converting other facilities to crude distillation and by other means individual to the plant, to provide for running more crude to stills.

However, the point has been reached where any further material increases in refinery output can only be secured by installing new additional plant capacity. Crude runs of close to 6,000,000 b/d will be required by the end of 1950, according to the best estimates, to meet product demand. Plant capacity of around 6,600,000 b/d will be required if 90% performance is met.

If refiners are to continue meeting this ever-increasing demand, they are going to need every pound of the 909,000 tons of steel which the industry has requested be allocated it annually. They are going to need it not only for the construction of new equipment, but also to maintain and repair existing equipment which is rapidly approaching the limit of its endurance.

Liaison with the Schools

THE OHIO OIL CO. has inaugurated a plan by which its director of personnel will spend part of his time officially at Wooster College, in Ohio, as a "career counsellor" for the benefit of the student body in general. While not the primary objective, this plan might prove to be the means for bettering relations with a most important segment of the public, on behalf of the petroleum industry and in fact industry in general.

The oil company executive will teach no classes nor give grades to students. His function on the campus will be to apply on behalf of those students who consult him his experience in furnishing vocational advice and information about business and industry, and to aid in placing students upon graduation.

Even with the refining companies who regularly take on a large number of the graduates of the professional schools, in most cases their direct contact is limited to the short time someone visits the schools once or twice a year to interview certain students with a view to hiring them. The companies benefit greatly from the fundamental training in their professions which these new men bring them. They could well consider some plan to provide the students, in return, with the means for acquiring some general knowledge of the functioning of industry while they are still on the campus. That would be sound public relations.

Bureau Is Its Best Salesman On Synthetic Fuels Program

ONE ALMOST TURNS to the back page of the "prospectus" to look for the application to buy stock when reading a so-called scientific paper by Bureau of Mines officials on the development of synthetic liquid fuels manufacture in this country, so glowing is the future presented for synthetic fuels as compared with that for petroleum.

A paper by R. A. Cattell, Acting Chief, Oil Shale Research and Demonstration Plant Branch, and J. D. Doherty, Assistant Chief, Office of Synthetic Liquid Fuels, of the Bureau, presented before the Pennsylvania Grade Crude Oil Assn., sums the entire program up in neat round numbers in two paragraphs:

"If private industry were to establish a synthetic-fuel industry adequate to produce 2,000,000 bbls. of oil and gasoline daily—half from coal and half from oil shale—the total steel required would approximate 10-12,000,000 tons, considerably less than previous estimates. Daily requirements for raw materials would total 500,000 tons of coal and 1,500,000 tons of oil shale. Coal being more difficult to mine than shale, 60,000 men would be required for the coal mines, as compared to 30,000 for the shale operations. Combined manpower requirements for the plants would approximate 200,000 men.

"Production costs would range from 6c a gallon for heating oil to 15c a gallon for gasoline, and the products obtained would total 700,000 bbls. of heavy fuel oil, 300,000 bbls. of light fuel and diesel oil and 1,000,000 bbls. of gasoline daily".

It's just as simple as that—until you come to an official report on a portion of the oil-shale project at Rifle, Col. Discussing only the work of the Mining Division of the oil shale project it is stated: "Considerable major research remains to be done on drilling and blasting problems, on integrating breaking of the shale with loading and haulage, and in establishing costs". But not many of the public, nor even of the petroleum industry, will read the latter report.

CHEMICAL USERS' GUIDE

to General Chemical Products for the Petroleum Industry

ALKYLATION

ANHYDROUS HYDROFLUORIC ACID
Grades or Strengths: 99.0% HF min. (one grade only)
Packing: Steel Cylinders, Tank Cars

SULFURIC ACID
Grades or Strengths: Standard
66° Baume—93.19% H_2SO_4
99% H_2SO_4
Diamond—66° Baume
Sulfuric Acid, Crystal—66° Baume
Packing: Tank Barges, Steel Tank Cars, Steel Tank Trucks, Steel Drums, also Carboys

OLEUM
Grades or Strengths: 15% free SO_3 (103.38% H_2SO_4)
20% free SO_3 (104.5% H_2SO_4)
65% free SO_3 (114.38% H_2SO_4)
Packing: Steel Drums, Tank Cars, Tank Barges

POLYMERIZATION or ALKYLATION

FLUOSULFONIC ACID—$HO{:}SO_2F$ (HSO_3F)
Grades or Strengths: Min. Content 98% Fluosulfonic Acid
Packing: Steel Tank Cars, Steel Drums

BORON TRIFLUORIDE, Ether Complex
Grades or Strengths: 47.88% min. BF_3
Packing: 5, 20 and 55 Gal. Drums; for Bulk Quantities write Baker & Adamson Products, General Chemical Division, Allied Chemical & Dye Corporation, 40 Rector St., N. Y. 6, N. Y.

SULFONATION

SULFURIC ACID

OLEUM

SODIUM SULFATE, Anhydrous
Grades or Strengths: Standard, approximately 99.5% Na_2SO_4
Packing: Multiwall Paper Bags

ISOMERIZATION

MURIATIC ACID (Hydrochloric)
Grades or Strengths: Standard—18°, 20°, and 22° Baume
Packing: Rubber-lined Tank Cars, Rubber-lined Tank Trucks, also Carboys

DETERGENTS

SODIUM METASILICATE
Grades or Strengths: Granular, thru 10 mesh; Powdered, 90% thru 40 mesh
Packing: Multiwall Paper Bags, Fibre Drums

DISODIUM PHOSPHATE
Grades or Strengths: Anhydrous
Packing: Multiwall Paper Bags, Fibre Drums

TRISODIUM PHOSPHATE
Grades or Strengths: Coarse, thru 10 on 20 mesh; Medium, thru 20 mesh on 100 mesh; Standard, thru 20 mesh, 15-25% thru 100 mesh; Fines, thru 40 mesh, 50% thru 100 mesh
Packing: Multiwall Paper Bags, Fibre Drums

TETRASODIUM PYROPHOSPHATE
Grades or Strengths: Anhydrous, Powdered, 100% thru 20 mesh, 90% min. thru 100 mesh
Packing: Multiwall Paper Bags, Fibre Drums

TREATING AGENTS

ALUMINUM SULFATE
Grades or Strengths: Standard-Lump, ¾"-2½" approx.; Ground, thru 8 mesh, 95% thru 10 mesh; Powdered, 97% thru 100 mesh; also Iron-Free Grade
Packing: Multiwall Paper Bags, Carloads in Bulk.

SODIUM SULFATE, Anhydrous

ACIDIZING

MURIATIC ACID (Hydrochloric)

MUD CONDITIONING

SODIUM SILICATE
Grades or Strengths: Clear and Opalescent Grades in a wide range of viscosities ranging from 38° to 60° Baume
Packing: Steel Drums, Tank Cars, Tank Trucks

DISODIUM PHOSPHATE

TRISODIUM PHOSPHATE

TETRASODIUM PYROPHOSPHATE

OTHER CHEMICALS

AQUA AMMONIA

SODIUM FLUORIDE

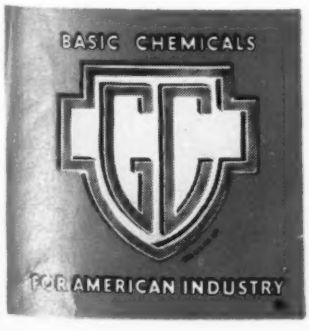
NITRIC ACID

HYDROFLUORIC ACID, 60%

OTHER HEAVY CHEMICALS

CATALYSTS and SPECIAL CHEMICALS

Companies requiring catalysts, addition agents, inhibitors, or other special chemicals "tailor-made" for their individual processes are invited to consult with General Chemical on their requirements. The same progressive research, technological "know how," and practical experience that has found the answer to so many petroleum chemical problems during General's long service to the Industry may provide the solution to yours, too.



The products advertised herein are commercial chemicals having various uses, some or which may be covered by patents, and the user must accept full responsibility for compliance therewith.

Baker & Adamson Laboratory Reagents and Fine Chemicals

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